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IN ALL THEIR DEPARTMENTS.

BY A COMMITTEE OF PRACTICAL SURVEYORS, ENGINEERS, AND ARCHITECTS, OF MUCH EXPERIENCE AND IN ACTIVE EMPLOYMENT.

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RAILWAY MONOPOLY.

NOTWITHSTANDING all the commendation and all the criticism that railways have met with, — the admiration of the velocity of travelling along them, the exposure of blunders that have been committed in their planning and construction, and the sorrow and indignation which have been felt and expressed at the fearful and fatal accidents that have happened upon them,—notwithstanding these, there is one view of them, and a very important one to the public, which scarcely any one has taken; and that is, the monopoly against the public which is established by the very nature of one and all of them.

This monopoly is a serious matter, from the mere fact of its being a monopoly; but it becomes a far more serious matter in consequence of some of the effects which arise out it, and which would not occur if it were not for the monopoly. Of these effects we shall, in the meantime, mention only one branch, and that is the accidents, which appear to increase in a greater ratio than the lengths of line travelled over. Our evidence of the fact of increase is the reports in the public journals; and that it is, in great part, owing to the monopoly, we think we can establish out of the mouths of the parties themselves.

The London and Birmingham line has, we believe, been the most expensive in the kingdom; and, if there is not more traffic upon it than upon any other, there is at all events a very great deal. Considering these things, and leaving the humanity of the matter entirely out of the question, one would naturally suppose that the directors and managers of such a line would employ no persons in situations of trust except such as were the very best qualified. So far, however, is this from being the case, that, at an inquest held on the 15th of November last, on the bodies of two men who had been killed by the collision of two trains on the preceding Thursday, near Harrow, the party attending for the company stated, as matter of course, and not as anything culpable, that, "though the instructions to the engineers were posted up in print at each station, they were generally given verbally to the men, *as few of them could write or read!*"

Now, calling the public indignation as strongly to this as possible, we would ask the directors of the company, and also others having superior situations on the line, how they can hold up their heads in society, or even sleep soundly in their beds, when a work of such importance is under this most shameful and dangerous management. The parties immediately engaged in the conducting of a railway-train have for the time the lives of all the passengers, who may be scores or hundreds, completely in their power and at their mercy; for, if it is death to meet the accident, it is just as certain death to attempt escaping from it when it is imminent,—and railway accidents are always imminent, and generally have occurred before the passengers have any knowledge of them, so the traveller must await the issue. Any one who is in the least acquainted with the doctrine of motion does not need to be told that he who leaps from a railway-carriage going at the rate of twenty or thirty miles an hour leaps with a forward motion of exactly equal velocity, and thus setting aside altogether the certainty of his getting a very heavy and dangerous fall, from the compound motion, he would have but small chance of clearing the wheels, even though in the very last carriage; and he would be morally certain of getting under them, if he leaped from any other. As matters are managed, indeed, the last carriage is just as dangerous to leap from as any of the others, because there is generally, if not always, some lumber attached behind this carriage, and in many cases a second engine, to push on the train. This second engine, though it gives additional power, is upon principle a very dangerous appendage to the train; because, if from any accident the leading engine should suddenly stop, this following engine would, before it could be stopped, tumble the carriages into a heap, and crack them against each other like nutshells. There is therefore no safe means of escape from a railway-train while in motion; and thus the passengers have no means of safety for their lives but in the skill, prudence, and constant watchfulness, of all the servants of the company who conduct the trains and superintend the lines. Need we add, under such circumstances, that the men employed ought to be possessed of the greatest foresight, the quickest observation, and the most perfect self-possession.

Now we ask the Directors of the London and Birmingham Railway, or of any other railway,—if men so purely mercantile, or rather stock-jobbing, in their dispositions, know anything about human nature, or care anything about the lives of passengers,—whether any but the greatest blunderheads upon earth would think of committing the care of the transit by railways to men, few of whom, according to their own admission, can write or read. If there is one male in the United Kingdom, and more especially a native of Great Britain, who has grown up to maturity, or something that may get the name, and not too old and decrepit for this kind of employment, and who yet can neither write nor read, we say that such a man is a mindless and reflectionless blockhead, and totally unfit for being employed in any situation of trust. We admit that the system of education in England for all but the most wealthy classes—and it is nothing extra even for them—is as bad as bad can be, and a shame and a curse upon those who have the power of making it better; and we also admit that the vile counterfeit which the ice-cold hand of hollow-sounding charity inflicts upon the poor is far worse than no education at all, inasmuch as it it is a mere name, contrived to prevent the parties from getting at the reality of themselves. We admit all this; but, so admitting, we do say, and we dare contradiction when we say it, that there is not now any man possessing the least spark of talent who will rest contented without learning to write and read, and possessing himself of much of the information which is derivable from the latter. The leisure hours of three short months, those hours which the profligate spends in the beer-shop, and the loiterer in perfect indolence, would in the case of any young man suffice for acquiring as much reading and writing, with very little assistance from any one else, as would put him in the way of getting on. Therefore, if we find a young man destitute of this very elementary education, we may always conclude that the fault is in himself; and that he is without observation and thought, and therefore unfit for being confided in. In the mere making of a railway, the animal power of such a person may be valuable for its department of the labour, just as the power of a horse, a locomotive engine, or the wheel of a barrow, is of value in its particular way. A mindless man, like those whom the sage directors employ in taking care of the transit upon the lines, may do very well for "getting" materials with the pickaxe, shovelling them into the barrow or the wagon, wheeling the former, or "tipping" over the head of the embankment; but, if he is employed where human life is concerned, and especially where the preservation of it is under his charge, of a surety the persons employing him are, by so doing, guilty of a most monstrous crime against society. They are not nominally assassins for hire, but they bring human life into peril, by employing incompetent parties, for the express purpose of saving their own pockets; and the moral difference between the two characters is small, and not easily seen.

But, though this habitual recklessness and frequent destruction of human life is a moral crime against society, of no common enormity, it is no crime "according to law;" and therefore, when the incapacity or carelessness, or both, of the servants employed, has been the cause, and the sole cause, of breaking the bones of a dozen of human beings, and destroying the lives of half that number, the directors, fortified by their act of parliament, sleep just as soundly as the Indian Thugs, protected by their goddess Bhowanee, do, after having strangled a whole caravan. As matters are managed, there is indeed a very considerable resemblance between Railwayee, in this

country, and Thuggee in India. The act of parliament is much the same, in the one case, as the mandate and protection of Bhowanee are in the other; and, under each, the parties may have murder committed with equal impunity.

Then, at the projection and starting of a railway, there is an attention to the "omens," just as there is at the commencement of a Thugs' expedition. In both cases, too, *Sou pukheroo ek Dunteroo*—"the *ass* is equal to a hundred birds;" and, if the schemers hear, loud and long, the *Pilhaoo* on the left, and the *Thibaoo* on the right, of asses braying for shares, onward they go with the most reckless confidence and brazen impudence.

Now, why should this be? and why should the legislature—all-wise, and all-powerful as they are—have tolerated it? They must have known, and they should have remembered, that a railway for general purposes is quite different from any and every private speculation, be that of what extent it may. The railway not only comes upon public ground, but it touches upon and deteriorates the public highway; and therefore the public—that public whose interests the legislature are sworn before their God to protect—has a first and paramount claim on their attention. So far, however, is this from being the case that we question if there is, in any of the acts authorizing the construction of their works, a single clause for the protecting of the public, or enforcing under a penalty—and it should be a heavy one in such cases, that all the works should be executed, and all the appointments made and managed so as to secure the utmost safety, and the smallest expense, of transit. We know that this would be a matter of great difficulty; because there is no general standard, and, though members of parliament may have the talent, they are never put in possession of the requisite data for any particular case. This, again, calls to our recollection that important function of the Institution of Civil Engineers, which we noticed in the preceding number of this journal; and, though it is not their business to obtrude themselves upon the House of Commons, yet it is the duty of the House to call in the aid of the institution before they allow another railway bill to be introduced. Then, when the proper examinations were made, and the report of the institution given in, the parties applying for the bill should be bound to follow the report by the most stringent enactments. In addition to this, there should be an annulling of the act, and a forfeiture of the railway to the public, in case of a serious accident, either from improper construction, or from unskilful or careless management. This may sound a little harsh; but it would require a wise casuist to say why a cask of wine which has not paid duty to the revenue should be forfeited, and a railway which does not perform its duty to the public should escape.

It would be ungracious to say that the parties in the direction of these railways are incapable of doing their duty; but we have frequent and fearful evidence that the duty is not done; and therefore we readily allow them whatever benefit public opinion and their own consciences may award them for possessing the capacity.

In most instances, these directors know nothing about the principles or the practice of railways; and, in not a few, the directors, have no interest in, or connection with, the district over which the line passes. They pocket their guineas for "looking in" at the meetings, which are always the most numerous possible in proportion to the quantity of business done—we say nothing of the quality; they come to these meetings with their minds fully occupied with other projects of business or pleasure, and, excepting the remunerative part, they forget the railway the instant the meeting is adjourned, or rather they know nothing about it to forget.

In proof of this, we may plead the small accommodation which even the most lengthy, laboured, and costly, of these lines affords to the country over which it passes. This, of itself, is conclusive of the fact, that these works are not in accordance with the wants of the public, but a monopoly against them; that the object has merely been to construct a line joining two points, and to make the greatest profit by getting this done, or rather by setting it agoing, without the least regard for, or concern about, any one interest or accommodation of the public. In confirmation of this, take the map, examine any line, and see how the towns are accommodated. On the London and Southampton, for instance, the only town approached for the first sixty-three miles is Basingstoke; and there there was no alternative, otherwise the parties would, in all probability, have availed themselves of it, in order to get the land they wanted a little cheaper. Take what line you please, and examine it as you may, you will find the same principle, or rather the same want of principle—that is of public principle—principle, attentive to the people's best interest, occurring through the whole; and the only conclusion at which you will be enabled to arrive shall be, that the whole of these matters are a monopoly against the public—schemes contrived by parties for their own benefit, all unheedlessly what good or ill they might do to others. This is the mainspring in all such projects; and, while it continues to be so, we shall never have a work what it ought to be, either in the plan or the conducting.

"Like master, like man," is a homely adage; but there is not the less truth in it upon this account; and, accordingly, we shall find that the sins of omission—and they are many—down to those which arise from the carelessness of the drivers and signal-men, "few of whom can write or read," arise out of their estrangement from the public, and indifference to its interests, on the part of those in the direction. We have been informed, and have no reason to doubt the veracity of our informant, that, at a time when some very serious accidents were occurring on one railway, the man in most confidential employment, and, as we should suppose, the most talented man connected with the line, was—Where do you think?—On the continent, looking out for jobs!

Now, if the directors and those immediately under them are thus inattentive, what can we expect from the men in humble situations, even though they all could not only "write and read," but could think a little also. If the railway is laid out and executed with no regard to the general accommodation of the public; if the directors are indifferent to the public interest; and, if the man most required upon the line can afford to be "on the continent looking out for jobs," it is hardly in the nature of things that an engine-driver or a stoker shall think there is any very great harm in taking a snooze, all overcome as he is by the soporific atmosphere of rancid grease and carbonic acid.

We have taken the fatal accidents that occur upon these railways as the first branch of evidence of inattention to the accommodation and safety of the public, which establishes, in so far, the fact of their being a monopoly against the said public, because they draw the attention more strongly than any of the other branches. But, while we have done this, we by no means wish to imply that a railway is, *per se*, a dangerous path for the traveller, or that the number of fatal accidents has been greater than it would have been to an equal number of passengers travelling equal distances by coach. On the contrary, we are inclined to believe, nay, we are quite certain, that the accidents have been not only fewer, but considerably fewer, in proportion, notwithstanding the blunders in the constructing of the lines, and the carelessness in conducting the trains. But railway accidents are formidable in the ratio of the momentum of the trains; and therefore, one of them, even though perhaps not more fatal to human life than the overturning of a coach, makes a greater impression upon the public mind than fifty of these.

It is herein, indeed, that the gravamen of the charge against those who have had, and have, the direction and management, consists. If a railway were in itself a dangerous line for travelling, and a locomotive engine and its train of themselves perilous to the limbs and lives of the lieges, we would at once denounce them, and laud the bunglers and the careless for doing all in their power to prejudice the people out of conceit with what is dangerous to them.

But believing, nay, feeling fully convinced, as we do, that a railway is not only beyond comparison the quickest and the most economical method of land-travelling, but that, properly managed, it is by far the safest—perfectly safe; indeed, we do feel a little honest indignation that incapacity, carelessness, and various other bad phases of human nature, should have bungled and tended to bring into disrepute with the public a scheme which, in itself, is so excellent. So complete is the control of man over all the working parts of a railway that, if even an accident occurs, it is his own fault. The power is unquestionably great—as great as the employer can wish for; and the momentum of a large train, arising from its mass and velocity jointly, is a very formidable matter in the case of an obstacle opposed to it. But every thing connected with the line—the rails, the engine, and the train, is susceptible of the nicest calculation before hand; and, were there proper knowledge, and due attention and care, there ought not to be, and there would not be, a single accident.

If, however, men, "few of whom can write or read," are to be employed, as is admitted to be the case on the Birmingham line, what is to be expected? Why, frequent accidents of the most distressing kind; and constant and most painful apprehensions to the timid. Instead of merely writing and reading — humble qualifications which are level to the capacity of any fool, every one employed in the working of a railway ought to know the principles of all that comes within his and the collateral departments; the whole principles of the line and its working. The directors may say that they could not get such men at the low wages which they pay to those who cannot read or write. But this is one of the charges against the said directors; they employ incompetent men, because they can get them at low wages; and thus endanger the lives of the public, for the sake of putting a little more money into their own pockets; and what they do thus most ingloriously gain is but a sorry bagatelle after all. Really they must have encased themselves in sevenfold bronze, otherwise they would be suffocated in the confusion of their own shame.

The next branch, and the only other one which we shall in the present paper urge against the monopoly, is that of its closeness, to the exclusion of all competition. But before we enter upon this, we must be permitted to say one word as to the expense of railway travelling. Of a full train, that is some twelve carriages, capable of carrying more, but actually carrying twelve passengers each, or 144, in which the expense is estimated at under 3*s*. 6*d*. per mile, but call it four shillings, which is 36 passengers for a shilling per mile, or a farthing and a half per passenger per mile; and this includes all expenses and reasonable wear and tear; and, if these are not reasonable, the fault lies with the people of the railway, not with the passengers. This will give *half a crown* for a journey of 80 miles, whereas the present price in the first class trains is about twenty shillings, or *eight times* what it costs the company; say that three-eighths of this go to pay the cost of making the line, and the profit on the passengers is still *four hundred per cent!* Is this to be borne? and are the people of England to suffer these jobbing and bungling adventurers to take away the public highways, and put four hundred per cent. profit into their pockets by so doing? John Bull has the character of being in his public capacity the fondest of all dupes; but, really, if he stomachs this, he may stomach anything.

The parties concerned may say, "The Acts of Parliament, the surveys, and the making of the lines, were very costly; and the expense of repairs is great." All this may be, and, we believe, actually is in most cases very true. But, then, whose fault is it? not that of the public certainly; and you have no right to look to them for payment for your own incompetent, blundering, or reckless way of going to work. *One halfpenny per mile* is an ample remuneration for the carriage of each person, and the public ought not to pay more, unless they do it of their own freewill for some extra accommodation; nor ought the public voice to be still, in Parliament or out of it, until the fare is brought down to this rate. The burden which this would take off the domestic trade and intercourse of the country would be vast, and the benefit to the more humble and laborious classes would be incalculable; because, although work were at a great distance, they could reach it for a mere trifle, which would be equally beneficial to workmen and employer, — and the effect would soon tell in a reduction of the poor rates.

But it may be pleaded, on the other side, that, without regard to the saving of time, conveyance by railway is cheaper than conveyance by coach. We shall admit this, upon the same principle that travelling by coach is cheaper than travelling in a sedan chair or a palanquin. But this is not the argument as it concerns the public; their business is to ascertain how cheaply they can obtain any kind of communication or transit, and endeavour to bring it down to that. In doing so, a fair remuneration to those employed ought always to be allowed, because without this the accommodation cannot last; but, while a fair remuneration is allowed as matter of justice, and equal advantage to both parties, care should be taken that the profit is not excessive.

When the parties and the public meet each other upon equal terms, they can adjust matters tolerably well; but, when the party in opposition to the public have got a "privilege," which is always, *de facto*, a wrong done to the community, and ought not to be received or extended in an enlightened age, the public are placed at a disadvantage, and cannot meet the opposite party upon equal terms. If the privilege is not of the nature of a monopoly, the public have some relief in the establishment of an opposition, if the privileged party is not so powerful as to bear that down; but, if the privilege is a close monopoly, the public have no resource but in complaint, which is always humiliating and unpleasant, and in the majority of cases not very successful.

The directors of railways come within this category of privileged monopolists. They have the privilege in their act of parliament, and their close monopoly in the nature of their line; and in this they are differently situated from all other carriers, whether on the land or the water. It is true that a canal is a monopoly as well as a railway; but still the canal, at least upon the present system of creeping along at a snail's pace, is not, like the railway, a rival to the public road. Whether, when our engineers have not much else to do — and we believe many of them are not over busy at present — they shall turn their attention to the improvement of canal-traffic, which seems to be a very fertile subject, we pretend not to say, but in the meantime, and with the present system of management, we may leave the canals out of consideration, in any question that bears upon railways. The public roads, and the navigable estuaries, and narrow seas, are thus the only subjects of comparison which are left.

Now, in the case of neither of these, can there be a monopoly of the same kind as there is in that of a railway. The coaches of one company may run those of another company off the road, but they cannot prevent the use of that road to a gentleman's carriage, a farmer's cart, or a pedestrian; and as little can they, by means of any property or privilege in the road itself, prevent a new company from starting, and in its turn running them off. In navigation, it is exactly the same: one company may ruin another, but they thereby acquire no property in the water, which remains just as free to the whole herd of adventurers and speculators as ever.

Not so with a railway: it is the private property of the company, or the individual, upon which the public, or any part of the public, have no right to come, and therefore there can be no opposition to it, no control upon its demands, however extravagant, but the formation of another line, which, in point of expense, is a very serious matter.

We are, however, inclined to think that these "rival roads" are by no means so serious a matter as they appear, from the example of those already completed or in progress. Independently of this and more unsavoury grounds of objection, the surveyors, engineers, and all others concerned, may be said to have been "trying their 'prentice hand" upon them; and, if these are, in any degree, what we suppose them to be in every degree, teachable persons, we should suppose that they could make the rival lines far more beneficial to the public, and at much less cost than the present ones; at all events, if that were any consideration to them, they have the satisfaction of knowing that they could not possibly make them more expensive, or less convenient to the public generally.

We do not, of course, mean that the new lines should run side by side with the old ones, for that would be a mere vexatious or party rivalship, and, as such, of little substantial benefit to the public. A new line, joining the extreme points of the old one, but as far apart in the intermediate space as possible, would unquestionably be the best, both for the parties undertaking it, and for the public. We are by no means certain that any of the already determined lines is the best between its extreme points, for mere transit, to say nothing of accommodation and benefit to the country; and we are pretty sure that nobody within the four seas knows what is the very best line between any two points at a great distance from each other. This, however, arises from sheer ignorance, and not from any thing like impossibility in the problem itself; and the best way would be to remove this ignorance, and then see what modification of the best line for transit would be necessary, in order to afford the greatest accommodation to the public. But no projector, no parliamentary agent, and no jobber, must have a hand in the matter, otherwise the cure will be as bad as the disease, and haply worse.

These rival, or rather duplicate lines, would give the traveller a choice, and thus perhaps enable him to get carried at a somewhat cheaper rate. But, if the reform of the matter went no farther than this, the traveller would only have the choice of two evils, —

his election as to whether he preferred the choice of having his bones broken, or his life extinguished, upon line A or line B; and this would be but a sorry alternative. What is wanted is, that, whether there is one line, or more than one,—and, in the latter case, whether the traveller shall make his election of the one or the other,—he shall be not only safe from accident, but have the feeling that he is safe in this respect. We have said, and we repeat it, and dare contradiction when we do so, that, if a railway is properly constructed, appointed, and attended, there cannot possibly be any accident upon it. Even at present, we believe that there has been no "accident" in the proper sense of the term, and that all the disasters which have occurred have arisen from ignorance and blundering,—both of which are faults of those in the direction, and not of the ignorant and incompetent servants whom, from selfish motives, they employ. To get at the root of the evil, and dismiss and disqualify for ever those who are the real authors of these sad calamities is the grand desideratum, and the question is, how this is to be done.

It must be done by a parliamentary enactment of some kind; and that parliament whose enactments have originated the evil, will greatly injure the public if it does not of its own accord originate the means of cure, by all that wisdom of which, in common parlance, it is so redolent. In the case of all railways which are completed, or have purchased all the land requisite for their lines, the cure is a very practicable matter; and the few which were "begotten in sin, and brought forth in folly," and are at present in abeyance, or *hors de service*, are not worthy of being made an exception. The purposes for which they obtained their acts of parliament have been accomplished, and so the acts are of no more use to them, except as covers for doing or continuing mischief. There is no objection to their retaining the power of suing or being sued as corporate bodies; but for every other purpose, saving that of mischief, or wrong done to the public, their acts have become dead letters; and the sooner that the statute-book—that great cesspool of all sorts of offal—is cleared of them, the better.

The same body—we say body—that has power to make acts of parliament, has power also to repeal them; and it has often displayed its wisdom more clearly and delightfully in the repeal than in the enactment. Therefore, let all the particular railway acts be repealed, with the exception of the corporate power in matters of law; and, let the honourable House, *cum avisamento tamen eorum Engineerorum*,—that is, with due advice of the Institution of Civil Engineers, not as individuals, or as a picked or packed committee, but in the majesty and wisdom of their mass, concert a general measure, which shall insure, under the severest penalties, and disqualification and confiscation, perfect safety to the limbs and lives of travellers by railway, in all parts of the United Kingdom and its dependencies. Such an enactment would hurt nobody, and it would restore to its deserved position in the estimation of the public, a most admirable mode of travelling, which has been woefully degraded by improper management.

But this, though in its own nature apparently a very practicable and simple matter, might be somewhat difficult in the execution. There are great faults and strong prejudices, "on either side the Trojan towers;" and how to correct the one and remove the other, *hic labor, hoc opus est*. The case is therefore an imperious one, and therefore the sooner the parties take it into consideration, the more creditable to themselves, and the more beneficial and tranquillizing to the public.

Of course, after the enactment of a general measure like this, of which we are afraid to hope, and unwilling to despair, it would, of course, be binding upon all lines of railway, both old and new; and it would be no bar in the way of any useful or necessary enactment in a new bill. Such bills would, of course, be necessary in all cases of new or extended lines, because without them the parties could not obtain the requisite land without paying, perhaps, an enormous price; neither could they act so well as a body. But the general act would be the security of the public against the machinations of interested parties; and this is a protection which the public are entitled to expect, and have a right to demand.

This is rather an unpleasant subject, and one from the consideration of which most people would be inclined to shrink. But it is one of the very first importance; and, therefore, we have hazarded these few remarks upon it, without regard to any personal consideration. We hope we have said nothing that can offend any party; but, if they should feel that we have, we can assure them that it is "accident" and not intention.

AGRICULTURAL ENGINEERING.—IMPROVEMENT OF THE LOWER VALLEYS OF RIVERS.

In such a country as Britain, engineers need never be at a loss for profitable, useful, and honourable employment, even at those neap tides of the sea of inaction, when the swell of the waters thereof, diminished in height and in impetus, casts up nothing new. Hitherto, the labours of the engineer have been chiefly confined to the manufacturing and commercial interests, and little or nothing has been done by him for the agricultural interest, which is the most important of any. It is true that a considerable portion of fen and marsh has been reclaimed; but Romney marsh shows that this was as well understood, or at all events as successfully practised, before civil engineering was a science, or even had a name, as it is now. It is also true that there have been improved methods of drainage introduced in cases where there was nothing of absolute fen or marsh; but the parties who introduced this were not engineers, in the proper sense of the term,—they understood how to drain the slope, and at the same time convert the marsh at its base into valuable land; but this was about the sum of their engineering knowledge. Farther, engineers, some of them men of first-rate ability, have submitted plans for reclaiming the bogs which unprofitably occupy so large a portion of the surface of Ireland; but, somehow or other, their plans have never been carried into execution; and they are, in all probability, now almost, if not altogether, forgotten by the very parties whose interests they were calculated, and meant, most eminently to serve. Leaving these, and some other collateral circumstances, out of consideration, we may say that the improvement of the land is a new field for the civil engineer; and it is one from which he might reap a rich harvest, both in glory and in gain. Our limits will not enable us even to enumerate all that he might do; and, though we had ample room, we are not sure if this would be the wisest plan, because the extent and variety of the subject might puzzle one as to what would be best for a beginning. Therefore we shall, upon the present occasion, confine ourselves chiefly to a single department, and that a very simple one,—the improvement of the valleys of rivers, in certain situations, by altering the courses of the streams.

If this subject were thoroughly investigated, and the results of the investigation skilfully applied in practice, it might be made of perhaps more real value to the country than any other subject that could engage the attention of the engineer. The economy of water is that of a double power, a mechanical one and a productive. The first is the cheapest of all mechanical powers which man can employ; and the second is one of the grand means of fertility,—and, were it generally and skilfully attended to, it would tend more to increase the quantity of human food, and thus diminish the price to the consumer, not only without loss, but with increased gain, to the grower and the land-owner, than all the statutary means of relief, about which there is so much clamour, even if those were increased twenty-fold. With respect to the first of these powers, or advantages, derivable from water, we have seen a steam engine employed in a part of the country where coal was very high priced, and within a very short distance of a stream which, duly managed, and that with little expense at the outset, would have done double the duty of the engine, if that had been necessary. Again, in reference to the second power or use of water, that of fertilizing the earth, and promoting the growth of wholesome and useful vegetation, we have seen the sloping sides of a valley completely parched and bare, at that very season of the year when the action of the sun was such that, with the accompaniment of a due portion of moisture, it would have been producing the greatest abundance, upon the very slope which want of due skill and attention had rendered useless. In close juxta-position to these barren slopes, the neglected and stagnant stream was converting the central part of the valley into bog and quagmire, totally unfit for the plough, pestilent for sheep, and abhorred by cattle.

Thousands of instances may indeed be pointed out in the British islands, and in those very parts of them that rank foremost in agri-

cultural name, where one portion of the surface is ruined for want of water, and another in the immediate vicinity is equally ruined by having too much; and, though this ruin increases every year, the owner and the cultivator merely stand by with their hands in their pockets, and grumble at the badness of the climate and the soil, which deny to the cultivator a remunerating crop, and compel the proprietor to abate a considerable portion of his rent when the audit day comes. The said proprietor gets due praise for his liberality in this matter; but truly it bears no small resemblance to the conduct of those parties who are described by the satirist as,

"For their beating, giving thanks."

It is, indeed, a melancholy state of things, that, while those who supply us with every other necessary and luxury of life are in such a state of progressive improvement as to be able to supply the public cheaper and better, and yet with increasing profits to themselves, those who provide that first and most essential of all necessaries, food, should lag so woefully behind. We do not say that this is universally the case, for there are many and splendid instances of the contrary; and, were it not that this might seem invidious, we should feel pleasure in enumerating some of the leading ones.

But, taking the general average, truth compels us to say that the agriculture — the grand food-producing art of the country — instead of partaking in that improvement which is so conspicuous and delightful in everything else, remains stationary, or falls sadly behind. We believe that, independently of all obstacles that may be thrown in its way, the improvement of agriculture is, in itself, more difficult than the improvement of any, even the most intricate, branch of manufacture. The materials which the manufacturer employs are all perfectly passive in his hands, and all the powers or forces which he calls to his aid can be calculated, and regulated to the amount of effect which is required. He has, so to speak, the entire matter before him; and, if he brings the requisite degree of knowledge, both of his materials and his processes, to the work, he not only must succeed, but will make improvements as he goes along, even without any direct intention of so doing.

With the agriculturist it is very different; his materials are not passive in his hands; and the powers along with which he works, or to speak more correctly, which he attempts to direct and regulate, are not susceptible of measurement, and they are in a state of constant variation. Hence, the agriculturist has not his whole subject under his management, even in any one place at any one time; and then, the nature of what he has to do must be so varied as to suit place and time, that it is difficult, if not absolutely impossible, to establish any system of general principles.

If a man has to furnish a nail, a shoe, a steam-engine, or any other product of merely mechanical labour, or even which requires chemistry and mechanics combined, the process is the same, in whatever part of the country or at whatever time of the year he may go about his work. But the agriculturist, in order to be at all successful, must accommodate himself to a great variety of circumstances, the study of which is most laborious and difficult; so much so, that men who fancied that they possessed, and actually got credit for being so thoroughly imbued with this knowledge, that they were appointed and paid for communicating it to others, have failed woefully whenever they attempted to put their hand to the work practically and in earnest.

If, therefore, they who profess to be most deeply learned in the principles of this most important of the arts fail in the practice, we need not be at all surprised though the practical men merely adhere to the practice, and never think of generalizing its results into any thing like principles or useful theory. It is a pretty common opinion in society, that the cultivators of the soil are by no means so acute and intelligent as those who are engaged in the mechanical arts, or in trade: but, general as this belief is, it is a fallacy. The farmer appears to know less than the others, for two reasons: — first, because he has a great many more subjects to study; and, secondly, because other people do not understand, and hence do not appreciate, these subjects. Naturally, therefore, the farmer is in a worse predicament than any other man who labours for his country; and for this reason he has more need for the services of the engineer, in all matters wherein the said engineer can assist him.

Of such assistance, however, the farmer has hitherto got marvellously little, in proportion to the need he has for it; and, though there are in the country at present a good many disposable engineers, we have not heard that any of them has tendered his services in this way. It cannot be that engineers are averse to interfere in this on account of the novelty and difficulty: for we suppose that, like all other aspiring men, engineers, after they get so far forward in the profession as not to be compelled to "trundle in the rut" for their daily bread, are noble hands for grappling with difficulties, and leading the profession onward to the broadest and hightest degree of extension and improvement of which it is susceptible.

There is, indeed, sufficient cause in another quarter for the engineer not being called in to give that aid in agriculture which he gives in the other useful arts; the party who should call him in will not, and the party who would call him in dare not. There is thus no encouragement for agricultural engineering, and, consequently, very little is known or cared about it: for nobody will professionally study a very difficult art, which is to yield neither glory nor gain.

The land-owner is the party who ought to employ the engineer upon his land, so that all its natural qualities and resources might be turned to the greatest advantage possible. The land-owner is abundantly solicitous to have the best horse, the finest equipage, and, in short, every thing which is calculated to dazzle the natives in town and country; but, in his over-attention to these matters, he is but too apt to overlook another matter, which is of far more importance both to himself and his country. He does not bring the commodity which supports all his state to market in the best condition; and, therefore, he places himself at a great disadvantage as compared with manufacturing and mercantile men. These, whatever else they may do, always contrive to bring their wares to market in the best saleable condition; and, if the land-owner neglects this, he must, whatever may be the breadth of his estates, be in a worse condition than the others.

This may not seem to have much connection with the improvement of the lower valleys of rivers; but it is the general case, of which that is only one particular branch; and, therefore, it is by much the most important. The neglecting of the improvement of their estates, the fact of not directing their chief energy to the bringing of these, their only commodity, to market in the best and most attractive condition, is the grand and only cause of that "agricultural distress" of which we so frequently hear, and which, under the present system of management, or rather the present neglectful mismanagement, cannot fail to exist. It is not the landlord who is primarily in distress, neither is it the farmer; for, though both of these suffer, it is the land itself which is really distressed; and, if it were cured, we should hear no more about the distress of the others.

The land is in agricultural distress, because the land cannot be wholesome and vigorous for agricultural purposes unless it is in a highly artificial condition, — which condition is maintained with more difficulty the more that the state of the land is changed from what it would naturally be if the hand of the cultivator were withdrawn. If the land-owner knew and studied his own best interest, he would take especial care to have, before all other considerations, his land in the very best condition, — that condition in which, with the highest possible rent to himself, there should be the greatest return and encouragement to the farmer.

There are cases in which this is actually done, and the good that results is great and obvious; but still those cases form only the exception to the general practice. With these exceptions, which, we are happy to say, are becoming so numerous in some districts as to be almost the rule, — we wish they were altogether the rule in every district, — the land-owner leaves the improvement and preservation of the land to the farmer. Now, the cases in which it is possible for the farmer to do this rightly are but few; and, in but too many instances, the landlord places him in such a situation as that it would be unwise in him to do it, even if it were physically in his power. In but too many parts of England the farmers have no leases, but are merely yearly tenants, who can be removed without any cause shown. Why this absurd and mischievous practice, the direct tendency of which is to make the land worthless, the landlord poor, and the farmer a slave and a beggar, should be clung to with so much pertinacity in many districts, it is not easy to say. Perhaps it may be owing to the mere love of power over the farmer; perhaps it may be the desire of turning this power to some political purpose; but, whatever it is, it must be bad; for, that which induces men to do evil that evil may follow, cannot in the nature of things be good.

But, granting that there were no evil in the matter, improvements of the physical condition of the land, upon such a scale as to require the professional engineer, can rarely, if ever, be undertaken by the farmer, and only in particular cases by an individual proprietor, without the consent and co-operation of his neighbours. Land-owners are apt to form clubs and associations for various purposes, — some absolutely bad, some only silly, and some with good names; but, if they would form themselves into associations for ascertaining all the practicable improvements of their districts, and carrying them into speedy and effective execution, they would be much wiser. Even the single case which we have set down as the title of this paper, "the improvement of the lower valley of a river," will generally require a concurrence of land-owners before it can be carried into effect; for, in the richer parts of the country, where improvement is most desirable and advantageous, it is seldom that the whole lower valley is in the hand of one proprietor.

But, independently of all considerations of the number of proprietors, or extent of property, the engineering which land requires is just as different from the proper operations of the farmer as the engineering of any work is from its execution. An engineer is, for instance, required to lay out a good line of road; and, generally, to point out how it ought to be made, and to see that his instructions are followed. But it is not necessary, neither do we think it desirable or proper, that the engineer should turn road-contractor and execute the work. We have very serious objections to contractor-engineers: because there is a conglomeration of offices, in the performance of which there is every temptation to jobbing, and no security against the practice of it. In such cases, the engineer is not competent, unless he can tell whether the work is rightly done; but he ought to have no hand or share in the doing of it. The Holyhead road, from Oswestry through Wales, is a splendid proof of the advantage of an eminent engineer in such works; but Telford was not the contractor for a single yard of it. In every other work it is the same. We want the engineer to plan, and the contractor to execute; but we do not think any one man competent to the proper discharge of both duties; and we are sure that no man should be allowed to undertake them both. The function of the engineer is to prepare work for the contractor; the function of the contractor is to execute the work so prepared: the first is a professional man, who works for his fee or his salary; the second is a tradesman, who works for his profit. These ought to be kept so distinct, that we have great doubts as to the propriety of paying an engineer or architect by a per centage on the cost of the work.

In whatever land may require, or admit of, at the hand of the engineer — and any one who has travelled in almost any part of England with his eyes open must be convinced that much is necessary and practicable — the distinction between the professional man and the tradesman remains precisely the same as in other cases. The business of the engineer is to prepare the land for the operations of the farmer, in as far as engineering can so prepare it. This ought to be done solely with a view to the improvement of the land, without any reference to the profit of the individual farmer. For this reason, the engineer ought to be employed and paid by the land-owner, who is to look for his remuneration in an increase of rent. And, if we take the cases in which any engineering operation, such as extensive drainage, embankment, &c., has been judiciously made, we believe we may say with truth that these outlays have yielded a better return, in proportion, than the mere land itself. A remarkable instance, though not on a very large scale, came under our personal observation many years ago. There was a detached glen or valley, some three miles in length, by rather more than one mile in breadth, opening by a very narrow gorge at the lower part, and cropping out everywhere else upon ugly moors of stunted heath and lichen, peat bog, and dull black pools, by the margin of which the rushes were dwarfed, and not even the common sedge would grow. These moors were parched in summer, pelted with rain in spring and autumn, and the winter snows fell heavy, and often did not clear away entirely till April; and it will readily be understood that such a neighbourhood was not the most favourable for that part of the valley which was susceptible of culture. The fact is, that the higher parts of the cultivated ground, the substratum of which was a coarse sandstone brash, known in that part of the country by the local name of "ratchell," and strongly impregnated with iron, was scourged by the winds and rains, till there was hardly any soil upon it, and the crops often did not ripen, and, when they did, they returned only a small portion more than the seed. The lower grounds, near the rivulet which meandered along the lower part of the valley, were, in many places, converted into bog and quagmire, which were unproductive in themselves, and dispersed blighting fogs over the lower slopes. The fact is that, with a soil in most places not very bad, with pure and limpid springs of most wholesome water in many places, and with excellent facilities for drainage in most parts, this glen was as wretched, in an agricultural point of view, as can well be imagined. The only grain crops that were attempted here were bere, or bigg, and oats; the first of which was often caught by the autumnal rains, and sprouted in the ear to such a degree that it was difficult to separate one sheaf from another in the shock; and the oats were so frequently whitened by the frost, before the grains had arrived at full maturity, that the crop was fit only for the fodder of cattle, and not the most nutritious and wholesome even for them. Under such circumstances the land, though there was no iniquitous burden of tithes or rates, did not average more than four or five shillings an acre; and this was far from a low rental, considering the real value. The proprietor had thus only a rental of £400 or £500 for his two thousand acres; and, as there was a large portion of this which, in consequence of the starving condition of the tenants, could hardly be paid, he had to eke out a miserable living, by exacting poultry, eggs, and other articles of food from his tenants, and binding them to perform a certain number of days of "bondage work" in the course of every year. This "bondage work" was, in reality, a very serious matter to the miserable tenants, because it took them away from their own little patches of cultivated ground, at the very times when their labours upon them were the most wanted; but still they were joyous times, because the people were better fed, and they were the only times of the year at which the majority of them tasted even small beer.

Whether there was any inherent power of improvement in such a state of things, we pretend not to say; for, though we could observe at that time, we were all too young for tracing successions of cause and effect; but a change was produced by something like an inbreak of the engineer. The proximate parts of the circumjacent moors were planted with Scotch firs and larches,—the last, by far the most profitable by the way. Catch drains were formed at the bottom of these plantations, to intercept the floods from the moors; a main drain was led in a straight line, or as nearly so as possible, through the sinuosities of the brook in the middle of the valley; and as many branch drains were formed as sufficed to clear the quagmires and marshes of that humidity to which they owed both their existence and their increase.

We know not who suggested these improvements, nor who was the master-spirit in the planning of them; but they were planned and executed, and their success was triumphant. Some fifteen or eighteen years rolled away before we again visited the place, and the change looked like magic: the plantations had succeeded well; the drainage had cleared away the bogs and quagmires; the climate was completely changed; the houses had all been rebuilt in a superior manner; and the crops and management of the farms had assumed a new character. The rents, too, had been augmented, so that instead of £400 or £500, the proprietor was in the receipt of from £2,000 to £2,500, paid at once on the stipulated rent days. The rent was paid chiefly from wheat, a grain quite unknown in the district when we left it; and the farmer had the greater part of the barley, all the oats, all the leguminous and other green crop, all the dairy, all the straw-yard and stall-feeding, all the pigs, and all the poultry, as the reward of his own labours; and upon these he appeared to be getting passing rich. This is the first instance of the benefit of the engineer in agriculture that ever came within our personal observation; but the result was so beneficial, and the impression made upon us was so great, that ever since we have anxiously wished to see the engineer employed to prepare the way for the farmer in every case where it is at all practicable, and can be of benefit to the district and the country.

It is to be understood that it is chiefly to the distribution of water that the operation of the engineer should be directed, in so far as the improvement of land is concerned. This water may be in excess, in deficiency, or in the situation in which it is least valuable. In the first case, drainage is the operation. Where practicable on a large

scale, this is, perhaps, the most valuable work to which the attention of the engineer can be directed. Lands, especially in the vicinity of the sea, which are naturally fen or marsh, or which have become so in consequence of long neglect of the outfalls of rivers, are always rich; and they want only drainage in order to enable the farmer to convert them into rich pastures, or productive corn-fields, according to circumstances; and, as they are less affected by the summer drought or the winter cold than lands more elevated, they make nearer approach to continual fertility than any other lands whatsoever. They have, in fact, a double value. The unimproved fen is not only comparatively useless in itself, but it spreads blight and mildew over the adjacent places, and loads the air with miasmata, highly injurious to man and to the more useful domesticated animals. But, when the engineer has drained it, and the cultivator has improved the surface, the humidity, which otherwise worked for evil, works for good, and the district is made healthy as well as rich. Much has been done in this way in Lincoln and the other counties on the Fen rivers, in Somerset, in Romney Marsh, and in other places; but much still remains to be done, and not a little of what has been done might be greatly improved. In the case even of the Thames, the judicious employment of the engineer might greatly improve the productiveness, the beauty, and the salubrity of the banks; and, if the corporation of London would judiciously expend in the improvement of that part of which they are conservators, the same sums which they waste in feasting and foolery upon the waters, even they might do a good deal. *Quoad* the present life, however, corporation men appear to be *binitarians* in practice, if not in faith. They have but two idols — their own stomach and their own purse; and to these they do homage in all their public matters and displays. We have schemers always now and then coming forward with projects for making the banks or bank of the Thames within the metropolis pretty; but the real improvement should have reference to the whole course of the river, from Lechlade to the Nore; and, if the matter were to be set about in earnest, we do not believe that one proprietor of land would have the hardihood to say, "You shall not improve the river opposite my property"— on the contrary, we feel convinced that he would be shamed into his share of the expense and the benefit. These are only one or two instances; but there are few rivers in the country which might not be improved to a considerable extent; and the parties interested would do well to bear in mind that the employment of the engineer in this or any other improvement of land is far more valuable than employing him in those operations called "works." If the subject of his employment is, for instance, a bridge, a harbour, a road, a canal, or a railway, however useful or necessary it may be, and how well so ever it may be done, it is still only an accommodation; and possesses in itself no productive power;— in short, it is a work for man, and for man only. But, when the improvement is made on the land, there is a double advantage: man is accommodated; and the productive power of nature — a power which costs nothing in the use, is roused from a dormant state to useful activity — and this power works while man sleeps, as well as when he is awake.

The second branch of agricultural engineering, that is, engineering with a view to improved agricultural results,—that of supplying water where it is deficient, is of even more value to the inhabitants of the globe, taken in all its regions and climates, than the getting rid of an over-supply; though, in a showery climate like that of Britain, this is not so strikingly the case. In many parts of India, and of other intertropical countries, the rains last for a very short time in all years, and in some years there are none. Springs and streams cannot, of course, be numerous in such places; and so the people have to solve rather a difficult problem: — to find water for the fields where there are no rivers, and very little rain. Tanks and reservoirs, which collect the rain when it does fall, are, of course, the only means that can be resorted to; and, although ruined and neglected during the frequent wars which devastated the country, the tanks of southern India are splendid ruins — far more interesting than those of temples, palaces, fortifications, castles, and all other subjects of antiquarian marvel. These may be evidences of greatness and power at some former time; but they may have arisen from slavery and misery on the part of the majority of the people. But no such doubtful or humiliating circumstance connects itself with the tank; because the only purpose of it is to supply water to the people and their fields.

In Britain, these are not so imperiously necessary; and there are not a few districts, even elevated ones, in which the people have naturally "too much of water." But there are a good many places where such stores would be of great use for the purposes of growth, and far more where the tank or pond water might be turned to great value as a power, more especially in those parts of the country where coal, and, consequently, steam power, is costly; and these are, also, the districts in which water is most required for the purposes of growth. The chalk ridges and plateaux of the south afford an instance very much in point. In the dry season, Salisbury plain, and the Wilts' downs to the northward, are sadly parched; while, at other seasons of the year, there is an over supply of rain. Now, if the portion of this rain which runs to waste, and impoverishes the fields by so doing, were conserved in tanks and ponds of the requisite number and extent, it might be made greatly to increase the productiveness of the ground, and, also, to perform other valuable services in the general economy of the district. It is impossible to get accurate data upon a subject to which so little observation and inquiry have been directed; but, independently of its value in the increased fertility of the country, we are sure that we are within the truth when we say that, in the whole British islands, one million horse-power of water runs idly, and, in many cases, destructively, to the sea every year. Besides the gain in power by keeping a considerable part of this upon the elevated ground, the atmosphere would be constantly kept nearer to the point of saturation; and thus we should have frequent and gentle rains during the hot season, instead of those heavy falls with thunder which now beat the bloom off the wheat, and commit other depredations. Under such a state of things, the succession of the seasons would also be more mild and uniform; and the frosts of spring would not nip the briard, or the rains of autumn rot or damage the crops, as they now do, in unfortunately too many parts of the country. Strange as it may seem too, to those who have not thought much upon the subject, the cultivator would better understand and anticipate the weather, and so be enabled to work more in accordance to it. It is as dependent on natural causes that the weather is so puzzling, and so much a field for the operations of every quack who has impudence enough to put forth an unmeaning jargon as a theory of the weather, and to prophecy boldly enough; for, if he is right one day out of the 365, the gulled and generous public dub him a conjuror in weather-craft, and seem to feel pleasure in being choused both of their money and their understanding. But, in so far as the weather is modified by cultivation, and it always is so to the full extent of that cultivation, it is brought within the sphere of rational science, and can be predicted on the ordinary principle of cause and effect.

The third branch of agricultural engineering, in the matter of water, the getting of it to those places where it is most valuable, is also of no inconsiderable importance, — more especially if it is made part of a system along with the former two. It is to the lower valleys of rivers that the attention of the engineer should be particularly addressed upon this branch of the subject. In them, generally speaking, the water is, except in some instances, for the purposes of navigation, in the very worst situation possible. Some rivers, indeed, as the Po, in Lombardy, and the Yellow river in China, have formed for themselves beds elevated above the general level of the districts across which they flow; and, where this is the case, the skill of the engineer is of the greatest service, in banking the river to prevent inundation, and in obtaining supplies from it to irrigate and fertilize the land. In this way, the valley of the Po has been converted into a great garden, some of the products of which are almost of tropical character; and the works on the Chinese river are far more magnificent and useful. In the plain of Ho-nan, the mighty flood of this river is kept in its channel by an artificial embankment more than 100 miles in length, though the bottom of the channel where the river passes Kae-fung-foo, the capital of the province, is actually higher than the ground upon which that city is built.

In Britain, we have no river of such violence and current as to form a channel of this kind for itself; and thus our rivers either rush headlong to the sea in their floods, tearing and sweeping everything before them, as they creep slowly along the bottoms, having a tendency to produce bog, marsh, useless vegetation, and unwholesome air. Both of these evils might be cured, or greatly

mitigated, by the skill of the engineer; and positive good might be effected at the same time, and for the same cost. But, as the modes of treatment are different, we shall confine those few sentences for which we have room to the latter. While we do so, the reader will have the goodness to bear in mind that no general system can be laid down so as but to meet the details of any one particular case of engineering. Each must be treated upon its own data; and this is the reason why an engineer requires to be, above all other professional men, a man of general knowledge and observation.

Suppose then, for we must suppose a case, that a stream of moderate size creeps slowly towards the sea, along a valley of considerable length and moderate breadth, and that the sources of all the principal branches are on the ground above the valley. Fall enough may, by artificial means, be obtained for one or two corn mills; but this would be obtained at the expense of some of the best land in the valley; and that adjoining will be injured by stagnant water. It is to be understood that *stagnant* water is, in all cases, unfavourable to healthy vegetation, in such a country as Britain, whether the land is in pasture or under crop; and that useful vegetation can be obtained by water trickling over the surface, which, of course, must have some fall or slope. This may be seen by examining two descriptions of water-meadow, often in juxta-position with each other, and watered by the same stream. One shall be formed into ridges, with feeding drains on the crowns, and waste drains in the hollows; and the other shall be left at its natural level, and the water let on and taken off as occasion may require. There may be very luxuriant herbage upon both; but the quality would be very different. Upon the ridged meadows, there will be the most kindly and succulent grasses, and not a marsh plant or particle of moss to be seen. But, upon the natural flat, where the water is merely let on for a time, and then let off, the whole vegetation will be scarce; and the inferior grasses mixed with marsh plants, and having moss among the roots. Farther, we believe that, were it not for the injury done by their feet in poaching, sheep might be put on the ridged meadow, even with the water upon it, without the slightest danger of foot-rot or liver-rot; whereas, upon the other meadow, the danger of both would be certain, and that in no great length of time. This is one of the elements which the engineer who would improve the valley of the river in the best manner must take along with him, and never lose sight of.

Then, with this, and with all other general principles, and with an accurate survey of the valley in all its surface and points, the engineer is in a condition for beginning his improvement. If he is to improve the whole valley,—and if not permitted to do this, he had better let it alone, as a bungled improvement now prevents a good one afterwards,—if he is to improve the whole valley, his first step is to select a point as high up the course of the river as possible; if there is a cataract or strong rapid, above that is the place; and, having the height of this pond above the outfall or tide way, or the confluence of the stream with a larger one, he is in possession of his leading data.

His next business is, to imagine the stream parted, in as nearly the ratio of the extent and importance of the portion of the banks below this, his head-land, as possible. Next, he is to lay out a new channel along each bank, preserving as uniform a height above the natural bed of the stream as possible; and he is to lay those channels as near as possible to any villages or any other objects of importance that may be near his lines. Cutting and embanking, and also puddling to make water-tight, will be required on the formation of these courses; and it would be desirable to form towing-paths, and a few locks, in order to convert the new channels into canals; but this would depend on circumstances, and not be absolutely necessary. Ponds on the course of the channels, and also reservoirs, to receive the water from the upper slopes, by natural streams or catch drains, would also be neccessary; and it would be desirable to form a pond opposite to every considerable village, farmstead, and mansion; the number and situation of which would, of course, depend on the circumstances of the particular case. Thus, every part of the valley would be supplied with water for any purpose, either as a mechanical or a fertilizing power; and the natural quantity furnished by the river might be increased by means of catch drains and ponds on the higher grounds, to the fertility of which, if rightly placed, these might also be made to contribute.

These works would complete the general means of distributing the water. But there would remain another work to be done: artificial watering requires the outfall of a waste drain; and the way of obtaining this would be to straighten and narrow, and, where necessary, deepen, the natural course of the river. This would be a work of some expense, but it would be one of great value. Much land would be gained, more would be improved; and, until the elevation became considerable, this channel would be far better for navigation than the original one, and could, at no very great expense, be converted into a canal. The floods, too, would be divided, and thus far conquered; and the matters brought down, instead of being wasted in the sea, could be collected in the drains and ponds, the cleansing of which, from time to time, would furnish a large quantity of valuable matter for compost manure.

This would, as we have said, require a concurrence of all the proprietors; but, as each of these would be benefitted in pretty nearly the ratio of his extent of property, it would not be *very wise* in any of them to stand out. It would also be expensive; and yet we feel convinced that it would repay the expense, sooner and better, than any work of mere accommodation.

Say that the valley was 16 miles long, and 1½ in average width between the new channels, and we might fairly calculate that the benefit would extend a quarter of a mile beyond each channel, so that the total average breadth would be 2 miles. This would give an improved surface of 32 square miles, or 20,480 acres; but, for the sake of round numbers, call it 20,000. Tithes apart — and we know of no just claim which either the clergyman or lay-impropriator have to the tithe of improvements, unless they pay a tenth of the expense — we should be inclined to reckon the advantage of such an improvement worth two pounds an acre; but call it one pound, and the lowest value, at twenty-five years purchase, would be just half a million.

Two thousand pounds a mile would cover the whole expense of the general part of the improvement; and the local applications would, of course, be made by the parties requiring them. One hundred and twenty miles, including the windings, might be taken as the total length of the two new channels, and the improved old ones; and the total cost of this would be £240,000. Allow £10,000 for surveys and contingencies, and the total would be a quarter of a million; so that, upon the least favourable view of the case, there would be a clear gain of £10,000 a year, which we feel convinced would practically be £30,000, if not more.

Such being the fact — and we are convinced that the more it is considered the truth will become the more apparent — it seems matter of especial wonder that it has never been attended to, or canvassed, even by engineers. From the proprietors of land, though the parties who would derive the chief benefit, we cannot expect that much would originate upon such a subject. Absolved in great part from the necessity of working for their living, either with their hands or their heads, they are not accustomed to long trains of instructive reasoning, however deeply they may affect their own interests; and thus we cannot, in their case, hope to pull the thistle of necessity from the rare tree of pleasure.

From the engineering and improvement-scheming world, we ought certainly to look for other, if not better, things; and yet, here also, we have looked, and still look, in vain. It is not that the engineers want talent for doing great, and very great, things in this way; for, whenever one of the requisite ability has been employed in an analogous work, he has done that well, and it has turned out to be most profitable to his employers; and therefore, if the engineers will pay due attention to this great national subject for the future, they should be let off easily for their past neglect.

That neglect, we are convinced, is also apparent rather than real. Engineers, in so far resemble physicians: they do not in the first instance make jobs, any more than these in the first instance make diseases. Whatever they may do afterwards, both parties are at the first merely "called in." Hence, we are inclined to think that the fault lies in the projectors. They are, of course, not fond of such an undertaking as that which we have been endeavouring to describe. It could not well be made a joint-stock matter and a job, with its reserved shares, gulled subscribers, and other sources of concealed, and far from honourable, profit; and thus they shun it, as they would any other fair and wholly above-board transaction.

But, notwithstanding the multitude of minor specs said to be in

petto, the cup of speculation begins to run heavily and foully on the lees. We suspect that the coffers of the credulous have run to waste at something more than fast-train speed on the best railway—as we suppose could be proved by an examination of present balances in the hands of bankers, and a comparison of them with those some eight or ten years ago. We do not very much regret this, because the money might have been worse spent, and would have been,—as in the case of a war or a mania for lending to foreign governments. But still, as we have done so much in the way of accommodation, it is time that we were doing a little in that of production. As we have enabled people to travel so much faster and cheaper, surely, for the sake of keeping the balance even, if for nothing else, we ought now to try how to feed them cheaper, or better for an equal expense, which is in effect the same.

Now, if the Institution of Civil Engineers were to attack this subject in real earnest, and bring their "great guns" to bear upon it, we are quite sure that all the country would hear the report, whether they saw the flash, or were touched by the bullet, or not. How honourable to the institution, how creditable to himself, and how delightfully inviting would it be to all ranks of the community, were there announced for the ensuing session, "A course of lectures, on the best means of rendering the soil of England the most productive at the smallest expense, by James Walker, Esq., P.I.C.E., &c. &c." We anxiously wish for something of the kind, though we are not sure that we dare hope for it; but we would scarcely have it at humbler hands than those of the president himself.

TABLES,

FOR THE USE OF NAUTICAL MEN, ASTRONOMERS, AND OTHERS.

THE COMPANY OF STATIONERS.

THE Stationers' Company deserve much credit for the publication of this very portable neat, and useful volume; and we hold the appearance of one such volume from their hall as full expiation for their former sins in the matter of Old Francis Moore, and Poor Robin: with their "heads, shoulders, elbows, knees, ancles, nails, &c. &c.," arranged under the denomination of the several planetary diversities. It is said, however, that, in the case of critics, "gladness brings the gall off the stomach;" and, though we are no critics by profession, and as little by practice as ever we can, we may as well get rid of a little which the name of the Stationers' Company has set a working.

There was a time when "Moore's Almanac" out-murphied Murphy in the matter of the weather, and was, withal, a good almanac to boot. Now it got its renown in the matter of the weather not from Francis Moore, physician, but from a committee of the stationers, long after Moore was in his grave. This committee used to dish up all the almanac with tolerable ease, except the weather, which was quite a lottery to them; and so, like honest tradesmen, they resolved to make it a lottery to the public. They got 365 cards, wrote the name of some kind of weather upon each of them; formed them into twelve parcels, for the months, the number answering to the days, and the weather for the average of each month, also the average of the parcel answering to it. They had one additional snowy day for leap year, which they put into January or February, and were thus far pretty right. The cards for the month were hustled in a night-cap, and then drawn 1, 2, 3, 4, &c., for the different days, and the weather on them marked down for the printer. One leap year, however, the odd snowy day got into the wrong packet, and was drawn "June 4." This was thought a bad business; but it turned out the reverse. There actually was snow on June 4, that year—nobody had predicted it but Moore; therefore Moore was the king of conjurers in the matter of the weather; and the sale of his almanac instantly spread over the whole country.

We dismiss all memory of the past with this our little reminiscence, and address ourselves to the production before us. We have already said that the book is very neat; but although this is all that need be said, and even all that can be said, in the case of a "Baby-book," or a "Boudoir Annual," it is but little in the case of so important a work as the present. Accuracy, perfect and undoubted accuracy, is the grand matter here; because an error in one figure might occasion an ugly blunder upon land, or a fearful accident at sea. The most patient reviewer that ever lived cannot be expected to verify every number in a collection of 38 tables, most of them the results of intricate calculations. But the Stationers' Company have, wisely we think, given those to whom the book is calculated to be useful, and they are many, the very best guarantee they could give for its accuracy.

The names of Dr. Olynthus Gregory, Mr. Woolhouse, one of the calculators of the Nautical Almanac, and Mr. Hann, of King's College, stand on the title page, as guarantee to the accuracy of the work; and he who refused the security of such a trio would be indeed a sceptic. "White's Ephemeris," which always was a respectable work, and which we suppose is now edited by the same parties, can be had bound up with the tables, and the whole make a complete *vade mecum* for the seaman at a very moderate price. All the more useful tables are given; at least, the only one we miss is the "variation of the pole star," which is very convenient in such a work as the laying out of a railway, or any other where a general check on magnetic bearings is necessary. Perhaps this may be lurking in some corner of the book, but we have not seen it. The trigonometrical tables are clearly arranged, and worth more to surveyors than the price of the entire book; and the "Natural Sines" are handy for such as are not quite *au fait* at logarithmetic operations, which, strange to say, is the case with some of the profession.

We shall give a case in illustration. Suppose the bank into which a railway cutting is to be extended is an angle of 10°, and the length to the crown 500 feet, what is the depth of cutting there, and the horizontal length? It is easy to understand that these, with the nature of the substance to be excavated, and the elevations at which the slopes will stand, are the data for finding the quantity of excavation, the expense and time of executing it, and the quantity of embankment that the excavated matter will form.

For the slope the formula is,

$$\frac{\text{Sine elevation} \times \text{length}}{\text{radius}} = \text{height.}$$

For the horizontal distance,

$$\frac{\text{Cosine elevation} \times \text{length}}{\text{radius}} = \text{distance.}$$

The elevation in our example is 10°, and the length 500 feet, therefore,

1. For height, sine 10° = .17365.
   Multiply by 500 = 868.2500.
   Divide by 1.00000 = 86.825 feet =
   86 feet 10 inches very nearly.
2. For distance, Cos. 10° = .98481.
   Multiply by 500 = 492.40500 feet =
   492 feet 5 inches nearly.

When radius is divisor, the operations are very simple; for we have only to make the natural sine or cosine all decimals, multiply by the sloping length, cut off as many decimals as are in the sine or cosine, and the figures to the left are integers of the same denomination as the sloping length. Explanations of the tables, and five nautical problems, are prefixed. These are, of course, perfectly accurate; but, somehow or other, we do not altogether like them. They are "schoolmasterish,"—that is, they go round about the difficulty, and then explain what is palpable enough without any explanation. But this is a trifle, and would not be worth mentioning in a book of inferior merit. We look upon the book as a real boon to those who need it; and, as such, we confidently and heartily recommend it.

TASTE, AS DISPLAYED IN THE LONDON MARKETS.

"A CONSTANT reader" asks us "why the British metropolis, with the most abundant and choice supply of viands of all descriptions, has its public markets the most tasteless and unseemly?" This is a question which very naturally arises in the mind of a stranger when he goes to visit, or even passes, any one of these places of public supply. The short answer to the question would be, that

"good wine needs no bush"—an excellent commentary, by the way, on the "gin palaces," upon which so much money, and such a copious outpouring of the tediousness of the very frowsiest architectural frippery, have been expended. But, waiving this, which is a subject not very obviously within the province of legitimate architecture, we do not think that the goodness of the article sold is any excuse for the unseemliness of the place of sale. If one is to have a more than ordinarily choice beef steak, one never thinks of calling for a dirty plate by way of bringing it down to the average; neither do we think that a dinner, or any of the constituents or appendages of a dinner, tastes a bit the more racy for being bought in a dirty market. On the contrary, it would be paying but a sorry compliment to the taste of the first city in the world to suppose that they who can afford a good dinner should not be equally anxious to procure propriety and elegance in all their appointments, and in all the accommodations of that city wherein they have made or are enjoying their fortunes.

We received the suggestion of our "reader" too late in the month for being able to go into a regular investigation of his question in the present number; but, as it is an interesting one as regards the honour, the seemliness, and, to a considerable extent also, the healthiness of the city, we have ventured to make a few passing remarks, in the hope that they may in so far draw the attention of others. In considering the state and accommodations of a public market, there are, apart altogether from mere convenience and architectural ornament, certain general points that appear to be but little understood or attended to. One of these, and a very important one, is, that the putrifying remains of any substance, whether animal or vegetable, are the most corrupting and deleterious poison to the same species of substance, both in the living state, and in that recent one in which it is most wholesome for human food. This is a general law of nature; and we know of no exception to it either in the animal kingdom or in the vegetable. If, for instance, fish are kept, or exposed to sale, in places where the air is foul with the vapours given out by the putrifying remains or offal of fish, such fish will not remain wholesome and high flavoured for many more hours than they would last for days in a place perfectly free from this contamination. It is the same in the case of all sorts of butcher's meat, and poultry; and it holds equally in that of vegetables and fruits—especially indeed as regards the flavour of these; and we believe it is a pretty general law, that flavourless vegetables and fruits are never wholesome or nutritious.

What has now been stated, as to the putrefaction of the remains of every species being, of all noxious substances, the one which poisons or taints that species the most readily, refers to substances supposed to be produced in what is called the natural state—that is, without any forcing by man. But the fishes which come to the London market, which, from the texture of their bodies, and the element in which they live, are all perishable in the fresh or recent state;—the fishes, with wild game, that is, game of the moors and not of parks or preserves, are the only animal substances that come to market in a perfectly natural state; and, leaving out that depraved taste which prefers semi-putrid game, every one knows that this wild game can be preserved in a perfectly wholesome condition for a much longer period than the flesh of any animals that are artificially reared and fatted. Now, the quantity of genuine moor or natural game that comes to the metropolis is so mere a bagatelle in respect of the whole quantity of animal food, that no conclusion can be drawn from it whereby to regulate the condition of the market places. Indeed it is so small, and eaten by so few, that the striking of it entirely out of the list would produce little or no effect. Besides the animal food, all the vegetables, whether fruit, leaves, roots, or any thing else that come to the London market, are not only artificially forced in their growth, but this forcing is carried to the utmost extent that the grower can carry it, whether by capital or by skill.

It follows, as matter of course, that all the provisions that come to the London markets are, with the few exceptions that have been named, brought to it in that very condition in which they are most apt to become tainted and to putrify. The bringing of them into this state is the result of improvements in the systems of breeding and cultivation; and, as by this means the quantity of provisions has been vastly increased, and the price thereby lessened, the interest of the public forbids any return back to the simple and unbred products of nature, as the means of general supply. Therefore, all that remains to be done—all indeed that can be done—is for those in authority and charge to take care that those articles which have a perishableness arising from the very superiority of the treatment they meet with shall get into the hands of the consumer in as sound and wholesome condition as possible.

This is a general subject, of which the condition of the markets, as places of accommodations, is only a single branch; but, as every part of it, in London alone, bears upon the health of a million and a half of human beings, it is obviously a subject of the greatest importance even in its single branches; and therefore the whole of it ought to be under a regular, well-organized, and most vigilant system of arrangement. It may be said that the public are, each for himself, the proper judges of the food they shall purchase; but those who would maintain such an argument as this would betray great ignorance of the matter. Of the vast multitude which we have stated as being the average population of the British metropolis and its neighbourhood, there is probably not one in a hundred who has time to make the requisite observation on this subject; and, of the whole, there is comparatively a small fraction that have the necessary ability. It is true that the respectable tradesmen who supply the upper and middling classes can be relied on; but vast multitudes, and they too the very worst judges, must make their purchases for themselves, and go about from place to place cheapening, until they meet with an article suitable to the state of their pockets. This class is exceedingly numerous in the metropolis, and more especially in peculiar localities; and, wherever this is greatly the case, inferior, and even injured and unwholesome, provisions are to be observed in the shops of the inferior tradesmen; and more especially in the case of some articles in the baskets of the hawkers who prowl about in the courts and alleys. So notoriously is this the case, that butcher's meat which nobody will purchase in the market of Leadenhall or of Newgate, finds a ready sale at Whitechapel, and many other places where the poorer working people are the chief customers.

This is well known to every man who knows any thing about the metropolis; and it must be intimately known to those who are in authority in those localities where it is perpetrated; therefore those authorities, and indeed all the authorities in the metropolis up to the very highest, incur a heavy responsibility for suffering it to go on. If they would know the consequences of their neglect, let them look at the personal appearance of those working people who get their chief supplies at such markets;—the operative weavers of Spitalfields, for instance, or any others who follow sedentary occupations in crowded courts or other confined and squalid places. Let them take note of the rickety spines, the distorted limbs, and the dwarfed size, of the young; at the premature decay, the stoop of years in middle-life, and the final exhaustion of the body at an earlier age than that at which the minds of men more favourably situated come to their full maturity. Let them look at these things, and see many thousands of human beings dwarfed to pigmies and reduced to skeletons; and then let them move on to the feast at the Mansion-house, and enjoy it with what appetite they may; or, rather, let them be men of moral feeling for once, find out the cause, remove that, and, by so doing, prevent the consequences in future.

Many will say that weaving is an unwholesome trade, and that the weavers are dissipated—that is, they drink whole pints of porter, and sometimes indulge themselves with a pennyworth in the gin-shops. These, the last especially, are sounding charges; and they tell upon the canting part of the world in the exact ratio of the length of ears. They suit well for declamation, from the pulpit, the platform, and every other arena of harangue; and the parties who are really guilty rid themselves of well-merited punishment by charging with crime, or great indiscretion, the very parties who have suffered from neglect of duty on the part of the chargers themselves. This is no uncommon way whereby the powerful and influential go about to make saints of themselves, by fastening sinner-craft upon the weak and unprotected. But neither the multiplication nor the cloaking of iniquity of this kind can in any wise improve its nature; on the contrary, the increase of it turns it into impudence, and the cloaking into hypocrisy; therefore, by attemping to get rid of the single crime of negligence, which might be cured, and that with no small degree of pleasure, they triple the

weight, and consequently take ultimate punishment of it upon themselves.

Now, how stand the facts of this matter as contrasted with the fancies? Why, weaving, and more especially silk-weaving, is not in itself, and necessarily, an unhealthy occupation. We have no wish that weavers, or any other men who must work should be as rosy as aldermen; but we have seen weavers who, in equal numbers, would have beaten the whole court, either physically or metaphysically; and the chief reasons seem to be, that these weavers had wholesome food—not glue-thickened turtle and semi-putrid venison, certainly, but something far more conducive both to physical and to intellectual health. Then, again, as to the charge of drinking, we believe there is very little foundation for it; and we suspect we are within the truth when we say that the majority of the common council of London drink more in a week than the majority of the Spitalfield weavers, or any other operatives whom the state of the markets allows to be fed on carrion and offal, drink in a month, or even in a year. It may be, and it very likely is, that, by being seasoned, the councilmen can carry their liquor better; and, barring the gout, they have generally stouter legs to carry it on, and thus they do not stagger in their potations, and so they avoid the night's lodging in the station-house, and the fine of five shillings. Thus they are paid for their steadiness, and their whet would upset men of less extensive practice. We do not, of course, confine these observations to common-councilmen, for we believe no line of distinction can be drawn between them and others of their class. But, when a specific name can be used, it is always more definite than a general one; and the name common-counsellor is the most general specific name which we can use with reference to London, because it does not apply to any one profession or trade. Farther, we use it with no disrespect or accusation of the parties named, but simply in illustration of a general principle.

The real cause of the physical inferiority of the sufferers alluded to is the unwholesome condition of great part of their food. They get it for little money, and thus they buy it with avidity, not aware that, besides the dangerous consequences of it, it is actually dearer than meat of first-rate quality and in the finest condition. There is more nourishment in one pound of the prime part of the best beef than there is in a stone of the "cagmag"—we must use the slang term—which is sold in a semi-underhanded way by the nefarious dealers. Not only this; for the good meat contains nothing but wholesome nourishment, whereas the bad is apparent food, but real poison: and, though it does not kill at once, like Prussic acid, it entails an after-life of feebleness and disease, which render the party ill able to labour, and beyond the reach of comfort or capacity for its enjoyment. The diseased state of the body so occupies and harasses the attention that the man cannot give his mind to his work with anything like the fulness and force of a man who is wholesomely fed, and consequently in good health; and the feebleness renders the hand as ill-fitted for execution as the mind is for planning and improvement. It should be remembered that the working men are the real honey-bees of society; that the duties which they discharge to society prevent them from making those selections which men of leisure can make, and also leave them no time for acquiring the capacity of doing so; therefore, in so highly artificial a state of things as prevails in England, and more especially in London, one of the very first duties of society, not of the mere employers of labourers only, but in every influential rank and denomination, is to take care, by every law which can be enacted, and every system that can be put in execution, that the working people are everywhere, and at all times, wholesomely fed.

We may go on even farther than this; for we strongly suspect that not a little of that love of stimulating liquors which, after every allowance for exaggeration, is but too common among the working classes, arises from the unsatisfying and unwholesome nature of their food. When the food does not digest readily, there is an unpleasant craving in the stomach, unlike that occasioned by wholesome hunger; and, when the digestive function is thus deranged, the nerves are disturbed, and the whole state of the body is uncomfortable. An opiate is naturally sought for, as a means of relief from this unpleasantness; and the grand opiate to which the humbler classes have recourse, if they have the means of procuring it, is ardent spirit, which may for the time make them not feel the annoyance; but, in the end, the stomach is more relaxed, and the malady is increased and confirmed. This is a point which demands the greatest attention from every well-wisher to the human race.

The evil is not confined to unwholesome butcher's meat, but extends to every article of food. Fish especially,—though all that are bad are understood to be destroyed at Billingsgate, if they get there in bad condition,—are often hawked about the streets, at prices sufficiently tempting to the poor; but in the most dangerous condition as food. Many instances of this might be cited, but we shall content ourselves with one, which we have on the authority of a medical friend. In the course of his practice, he was called to the dwelling of a poor woman who had fourteen children; and, on arriving, he found them all affected with most excruciating pain in the stomach, and some of them in strong convulsions. It was impossible, indeed, to see a more melancholy sight than this woman and her fourteen children in such a state, considering that they had been all in health in the forenoon of the same day. In casting about, as a careful practitioner does so peculiarly, the doctor spied a dish with a quantity of herrings upon it; and it did not require a near approach to tell him that they were in a state of putrefaction. Upon inquiry, the woman at once told him that she had purchased, of an itinerant vender, about a hundred of these herrings for a very few pence; and that, not having had such a feast for some time, she and her children had all eaten heartily of them for dinner. Knowing the cause, the doctor set about applying the most efficacious remedies as promptly as possible; but, in spite of all his ability and zeal, five of the children died; and the woman had her constitution so shaken, by the joint effects of the disease and the medicines, that she was bent almost double for the remainder of her life; and, though necessity compelled her to work as much as she could, her exertions were feeble in comparison with what they had been before this unfortunate dinner. This is but one case out of thousands; and, could we get at all the destruction of life and comfort which has been produced by the sale of unwholesome food in London, the amount would be perfectly horrifying.

It will perhaps be said that all this has little to do with the state of the public markets, and still less with engineering; and we readily grant that, as at present managed, there is no engineering in the matter. This, however, is the very evil of which we complain. We demand—or rather, public justice demands—that there should be a superintending spirit pervading the whole system, intimately acquainted with all the parts, and taking the most scrupulous care that each and all of them should at all times work solely for the good of the public, and that in the most efficient manner. According to the present reading of the vocabulary, this may not be named as engineering, but it is in reality engineering, and that of a very high and important order; and one of the greatest evils with which this country has been, and is afflicted, is, that the real engineer—the man who has grasp of mind sufficient to embrace and comprehend the whole, and all the parts, of an extensive and difficult subject, has been tied up to insulated and mechanical scraps—for we can call them no better in comparison with the health and comfort of all the people—such as planning and superintending the execution of what are called "Public Works."

Hitherto, the attention of the persons called engineers has been wholly directed to the mere accommodations of society, or rather of septs or parties in society, without any regard to the food, the health, or the comfort, of the whole; and yet these stand far more in need of engineering, that is, of thorough knowledge and vigilant superintendence, than that about which engineers have been occupied. Now for the other objection to the case we stated, the fact that the poor woman did not buy the putrid fish in one of the public markets. In this, we think there is little weight; for however many steps the fish passed through, and whatever might be done at any of these to deteriorate them, the fault is originally in the conservators of the public market, who do not see that there is no wrong done at any, even the remotest, step in the succession.

Speaking of fish naturally leads us to Billingsgate as the first public market to be examined; and here we must say that, though there is often abundance of good fish there, the place is abominable and revolting, in every sense in which the words can be taken. In the first place, there is no decent approach to it, and it is so coarse and filthy in all its appointments, that no person—more especially a respectable female, can dare to visit it. The water around it is full of the trimmings and most offensive offal of fish; and the ooze

and mud, for a considerable distance both above and below it, is mixed with a large portion of the same. Therefore, the very air of the place is tainted with the gases given out by putrefying fish, or fishy substances of some kind; and the principal gases which these give out are sulphuretted and phosphoretted hydrogen, the most offensive and the most poisonous that can be named. These gases are perhaps not so deleterious to human health in the neighbourhood as their abundance and virulence would lead one to suppose, though they must be deleterious to some extent. Upon the quality and flavour of the fish, their effects are much worse; for, if a fresh fish is left but for a very short time exposed to the effluvia of putrefying fish it gets tainted; and, though the dealers try to prevent this by sluicing the fish with water, yet this sluicing destroys much of the flavour, and a good deal of the quality.

This is an evil too—or we may at once call it a nuisance—which goes on every day, but is always greatest in those states of the season and weather under which fish are most apt to spoil,—in summer more than in winter, and in close "muggy" weather more than when the air is dry and bracing. The reason is, that there is a great deal more produced in warm weather than in cold; and that the vapours are less readily taken up and dissipated by the close muggy atmosphere. One of the greatest evils is the discharge of the refuse into the water, all round the places where the fish are laid, and the consequent invasion by putridity upon all sides, so that, in respect to situation, this market, except for the purposes of monopolist salesmen, whose business is transacted at early dawn, the great fish market of London could scarcely be worse than it actually is at present. When Hungerford Market was at first opened, the intention was to carry at least a portion of the fish trade there. But the lords of cod and turbot at Billingsgate effectually prevented this, probably because they saw or fancied that the new market could be visited by the public, and that thus the powers and profit of their monopoly might be in danger, far more than they are in the present place, which nobody can visit without trouble and annoyance, or remain in with impunity.

We have said nothing of the accommodations or taste displayed at this market, for there is literally nothing to be said; and we shall reserve our farther remarks on all the markets, the general system, and its effects, for a future occasion.

INSTITUTION OF CIVIL ENGINEERS.

"Philo-technikos" asks us, "What dislike we have taken to this respectable institution, and what injury it, or any one of its members, ever did to us?" To which we answer, most unhesitatingly, that we have no dislike whatever to the institution, neither did it, in its general capacity, or in any one of its members, ever do the slightest injury to us. On the contrary we hold the institution in the highest possible esteem; we believe its members are above doing voluntary injury to any one; and, in the slight connection which we have had with it, it has always treated us just as we expected to be treated by such a body—that is, with the utmost politeness and attention. With the institution, or with any other party, we wish to have as little connection as possible; for, the whole public are our party, and the public good is our object; and so we wish to stand perfectly independent, and free to praise, advise, or reprehend, as our notions of the public good may require. If, in the paper to which our correspondent alludes, we saw cause to find fault with some of the proceedings of the learned body, we are sure that we did so in no unseemly terms. We thought, and we think still, that in many matters they are not useful to the public in any thing like the ratio of their talents and facilities; and, thus thinking, we should be neglecting our duty, if we did not give them a few gentle words of remonstrance on the subject of theirs; but, in this, we know that they will take no more of our advice than suits them; still we have the satisfaction of doing what we feel to be our duty to the public, the only masters whom we wish to serve, and the only patrons whom we wish to court.

We are very proud to reckon among our readers any member of any one of the three professions whose names are included in our title; but we do not write exclusively for them or for their benefit. There is a close and important relation between them and the public; and there are many channels yet unopened in which they might be of much value to the public, with no small honour and emolument to themselves. Three channels we wish to point out, and call the attention of both parties to them to the utmost of our power; but we must do this in our own way, if we are to do it at all.

One subject, in particular, we may mention; we wish to see engineering influence, or rather knowledge, more dominant in the houses of parliament than it has hitherto been; and, in order to effect this, engineers must take high ground, and maintain it sturdily. We should wish to see, not merely the spirit, but literally the system and practice of engineering—that is, perfect understanding and careful superintendence—introduced into every department throughout the country; and just because we think the institution of civil engineers eminently calculated to originate and give effect to this good work, we shall let slip no opportunity of persuading them, by every means that we can, to show themselves efficient for the performance of so necessary and valuable a duty. They must, as a matter of course, show their capacity in their present sphere in the first instance; and we can imagine no better way of beginning to do this, than for the president of the institution to deliver to the members, in their hall, at the opening and the close of each session, a full, clear, and explicit account of the state of engineering all over the world, with an estimate of the advantages likely to result from each particular work.

GOODS BY RAILWAY.

It gives us great pleasure to state, and that upon the information of an extensive Sheffield manufacturer, who speaks from his own experience, that Sheffield goods can be brought to London by railway at half a crown cheaper per hundred weight than they can be brought by horse power, besides the comparatively smaller time that they are on the road. This cheapness, combined with expedition, cannot fail in being of the greatest advantage in the case of all such goods as are not well suited for canal carriage, which, after all is, or might be made, the cheapest for heavy commodities. There are, however, various articles in general demand which do not answer well by canal carriage. Among these are included cutlery, plated articles, and all others in polished metal, which are liable to be tarnished, or even more seriously injured, by the damp and vapour of a canal carriage, especially at the comparatively slow pace at which canal boats creep along.

We say we are glad at the receipt of this information, because we never had any doubt as to the superior value of railway carriage for various descriptions of goods, and for the safety of every class of passengers. If we have found fault with the present system—and we think we have had frequent and just occasion to do so, our objection lies not against the railways, but against the faulty structure and careless management of them. On the contrary, we look upon them as one of the greatest boons that science ever bestowed upon the world; and we deal rather sharply with their faults, just on account of their superior excellence, and the perfect safety which a judicious management of them would to a certainty ensure. Such being our firm conviction, and from an earnest desire to see the execution and the after-management, in all cases, worthy of the original idea, we must be excused, if we deal a little more sharply with their faults than we would do if they were of minor importance in themselves.

ON BRIDGES:

READ BEFORE THE BATH AND WEST OF ENGLAND SOCIETY FOR THE ENCOURAGEMENT OF AGRICULTURE, ARTS, MANUFACTURES, AND COMMERCE, DECEMBER 8, 1840.

BY J. DREDGE.

Few things in Mechanics are of greater importance to Agriculture and Commerce than Bridges; and any improvement in their construction is an object not only worthy of the most serious consideration of the members of this Institution, but also deserving the attention of most men of every country. Indeed, the immense loss of property, and the great inconvenience so frequently sustained in various parts of the globe by the destruction and want of bridges, ought to stimulate every well wisher of art and science and *his*

country to assist in finding out the real cause of such *lamentable circumstances.*

That either compression or suspension bridges, no matter of what material, should be crushed under their own weight, or be destroyed by the effects of a gale, the pressure of a transit load, or, in fact, that they should at any time break down before they are fairly worn out, is a subject that deserves the most *searching investigation.* A bridge is a structure of inestimable value, and ought to last as long as the material of which it is built; but this is not the case, for nothing is more common than to hear of the destruction of new as well as of old bridges. If any implement, such as the common spade or shovel, or any other ordinary instrument, did not endure a reasonable wear and tear, the cause of it would be easily found out; and the great *defect* that exists in the *construction of bridges* would be discovered with the same facility, did we not allow custom and other *circumstances* to *warp our judgment.* The view that I take of bridges is, that they are only brackets, and should be dependent on their bases or abutments, and the strength of the material of which they are constructed, like the human arm which depends on the shoulder, and not on the fingers' ends; or the limb of the oak, which is sustained by the larger part of the branch that grows from the tree, and not by the ends of the twigs at its farthest projection. But bridges have hitherto been made to rest on their centres, as beams in architecture; and hence the superfluous material in them, with the immence accumulation of leverage that exists on their centres, is the cause of their undulation and destruction. For instance, in a common bridge, whose depth is $\frac{1}{20}$ of its length, and the weight 1000 tons, the central forces are 5000 tons, instead of which *no description of force or weight should exist on the centre of the arch of any bridge, for it is but the extremity of two projections.* Thus, then, in this bridge, from its mode of construction 666 tons of material, and 4500 tons of power are lost; or, in other words, the same material would construct three bridges of the same dimensions, and each of them would be 4500 tons stonger.

The system of bridge building which I am now, and have been for some years' advocating, was partially carried out in the construction of a compression bridge at the Castle of Wandipore in Thibet, in 1640; which, after having stood 143 years was examined by Captain Turner, and he states, in his "Narrative of a Journey through Bootan, and a part of Thibet," that the bridge was constructed of timber, and that it had never been painted or *protected by any means from the weather*, and that then, in 1783, it *was perfectly sound.* The reason I have alluded to this bridge, of which I have a drawing here, is merely to show that, had it been of the same dimensions at the centre as at the abutments, like the common bridges, three times the material must have been used in its construction, and then, instead of lasting 143 years without exhibiting any marks of decay, it would not have lasted as many days; in fact it must have been crushed under its own weight.

In 1836, this system was carried out in the Victoria bridge, in this city, and since then Lord Western, in a letter to Lord Melbourne, has most clearly explained the unerriug truth of the principles on which it is founded; and I have models here which will prove it.

Mr. Dredge illustrated his statement by an exhibition of the models.

Dr. Wilkinson then spoke in high terms of Mr. Dredge's system. The subject, he said, had excited much of his (Dr. W.'s) attention, and, though several years ago he felt a prejudice against Mr. D.'s plan, since he had read the letter of Lord Western on his Bridge, and more closely examined its principles, he had found his conclusions to have been at first formed rather hastily. Dr. W. went into a scientific account of the mechanical laws and arrangements by which Mr. D. had been guided in his mode of erecting bridges; and an analogical illustration from the structure and physiological use of the human spine, to show how provisions had been made in each case, for adapting the mechanical strength to the position and point of pressure which mostly demanded it.

A few questions were put to Mr. Dredge by gentlemen present, which were answered satisfactorily, after which the Chairman expressed the great gratification the meeting had experienced, and the obligations they were under to Mr. Dredge for his kind and valuable communication.

SCIENTIFIC SOCIETY.

The second conversazione of the Scientific Society for the present season took place at their apartments in Great Russell-street, Bloomsbury, on Thursday evening, Dec. 17th, when the chair was taken by George Alexander, Esq., V. P. The attention of the members and visitors was engaged by a communication, submitted by the curator of the society, on fossil remains, as records of the relative ages of the various stratified rocks. In this paper the author dwelt upon the scientific value of these memorials of by-gone conditions of our globe, and claimed, for geological science, the honour of tracing the order and duration of events which were never seen by human eyes, or recorded by human hands. The interest of this subject will be fully appreciated by the lover of geological pursuits. The principal objects of interest in the rooms were some specimens of terracotta manufactures, from Messrs. Routledge and Company's patent cement works, and Potts' patent rail for suspending pictures, the utility of which was fully explained to the meeting by Mr. Nottingham.

INSTITUTION OF CIVIL ENGINEERS.

Continued from page 261.

"Description of an Apparatus for preventing the Explosion of Steam Boilers." By Robert M'Ewen.

The frequent explosions of steam boilers, caused in many instances by the steam being confined until it acquires a density greater than the boiler can resist, induced the author to invent a simple, self-acting apparatus, intended to warn the engineer whenever the pressure exceeded the proper degree of safety. The apparatus under consideration is constructed on the principle that steam, in proportion to its density, will support a column of water, or mercury, of a given height, and that any fluid will find the same level in two or more vessels, provided there be a free communication between them. It may be called a mercurial safety valve, and consists of a cylinder, within which are two cups, with two pipes dipping into them of a length proportioned to the pressure of the steam; these pipes are connected at the top with two valves on one spindle, so arranged as that, when one is open the other must be closed. On the top is a waste steam pipe open to the atmosphere. One pipe being filled with mercury, and the valve connected with it being open, the mercury remains stationary until the pressure of the steam exceeds its proper point. It will then be blown out and fall into the empty cup, allowing the steam to escape by the waste pipe, and giving warning to the engineer by its noise. When the pressure is again reduced to its proper point the valve is reversed, and the mercury will, on the next occasion of an increase of pressure, be blown up again, still giving warning on either side.

"On setting out Railway Curves." By Charles Bourns, Assoc. Inst. C. E.

Mr. Bourns having been engaged in setting out the Taff Vale Railway through a country presenting circumstances of more than ordinary difficulty, which rendered it necessary to vary the radii and the flexure of the curves frequently, his attention was particularly directed to the subject; and he has treated it in this paper clearly and successfully, demonstrating the several cases geometrically, and generally in a plain and satisfactory manner. He calls attention to the inaccuracy of applying a square to the setting out of segmental curves, particularly those of short radii, and recommends an offset staff as theoretically correct and practically much more convenient. The general rule to find the offset is — "Divide the number of inches in the chain used by the number of such chains in the radius of the required curve; the quotient is the offset in inches." The paper is accompanied by a table of offsets for curves of different radii; which the author found extremely convenient for use in the field.

"Description of an instrument for describing the Profile of Roads." By Henry Carr, Grad. Inst. C. E.

The object of the author was the construction of a machine which, being drawn along any road of moderately even surface, should describe the section of the line over which it passed. It is evident that, if a pendulum be suspended from a frame standing perpendicularly when the machine rests on a horizontal plane, on passing over a plane inclined at any angle with the horizon, the pendulum must form the same angle with the frame, the tangent of which angle in terms of the radius will be the rise or fall of the plane. The duration of the tangent will be determined by the paper on which the section is drawn being made to traverse at a speed proportionate to the distance passed over; and the extent, by the difference of the speeds of a nut and screw, which are made to resolve in the same direction — the nut turning at a constant velocity, and the screw at a speed differing from that of the nut in proportion to the tangent, slower or faster as the tangent is *plus* or *minus*,

raising or lowering the nut according to the deviation of the plane from the horizontal line. The machinery is set in motion by the wheels of the carriage, and a series of wheels and pinions of given diameters cause the ground line and datum line to be drawn simultaneously by two pencils on a paper which gradually unfolds itself from one drum, and is transferred to another at the rate of 16 inches per mile passed over, or on a scale of 5 chains to the inch. A profile of a line of country may thus be obtained with sufficient accuracy for a preliminary survey.

May 12, 1840.—"Photography, as applicable to Engineering." By Alexander Gordon, M. Inst. C. E.

The object of the author in this paper is to direct general attention to the advantages which may be expected to result to the profession of the Civil Engineer from the discoveries of Mons. Daguerre and others, in enabling copies of drawings, or views of buildings, works, or even of machinery when not in motion, to be taken with perfect accuracy in a very short space of time, and with comparatively small expense. This system of copying not only the outline, but the tints of light and shade, united with accurate linear perspective, he contends may be easily adapted to the purpose of the engineer, as well as to all those professions in which the art of drawing is used. The photographic apparatus has already been employed to bring before us exact copies of the most interesting monuments of antiquity, the French antiquarians and artists having found it more easy and correct to Daguerréotype the Egyptian monuments and decipher the hieroglyphics at their leisure, than to labour over the originals.

The subject is divided into two branches: the first being the art of copying drawings and plans by the transmission and absorption of light by prepared paper. The drawing to be copied is placed between two pieces of plate glass, held down in close contact with a sheet of photogenic paper, prepared by being washed over on both sides with a neutral solution of nitrate of silver of a specific gravity of 1·066, and afterwards with a solution of common salt and water (1 lb. of salt to 25 pints of water. The paper thus prepared must be dried and kept in the dark, on account of its peculiar delicacy. The rays of the sun are then permitted to pass through the white portions of the drawing or print, while they are interrupted by the black lines, and more or less by the tinted portions. The rays of light thus act upon the prepared paper, and produce in a few minutes a reversed copy, reproducing the lights of the original in shadows; this can be remedied by taking a second copy from the first, and thus the shadows are restored to their original positions. To destroy the sensitiveness of the prepared paper and preserve the copy, it is soaked in pure water, which carries off the excess of nitrate of silver, then covered with a solution of hypo-sulphite of soda of a specific gravity of 1·055, and again washed in pure water, so that when dried it is permanently fixed. It is evident that a copy thus obtained must be exactly like the original, and the value of such a process may be readily estimated by engineers.

The second branch, which is named "Daguerréotype," after the distiingushed artist who brought it to its present state of perfection, is of a much higher order. This is the art of fixing and preserving on the surface of a polished silver plate the images collected in the focal plane of a camera obscura. The process is rather complicated, but may be thus described. The surface of the silvered plate being cleaned and polished very perfectly by means of finely levigated pumice stone, olive oil, and cotton, is rubbed lightly over with diluted nitric acid, in the proportion of 1 pint of acid to 16 pints of distilled water; it is then subjected to the heat of charcoal or a spirit lamp until a firm white coating is formed all over the surface of the silver. The plate is then suddenly cooled. This process is repeated three times. It is placed in a dark chamber with the face or silver surface downwards, where it is acted upon by the spontaneous evaporation of iodine; this condenses upon the silver, and produces a fine gold-coloured surface, extremely sensitive to the impressions of light. It is then placed in a camera obscura, the light having been until then perfectly excluded from it. It there receives the impression of any images brought within the focal plane; and by subsequently exposing it in a dark, close chamber, with its silver surface downwards, to the fumes of heated mercury, the images are rendered visible; to fix the images so received, the iodine is removed by dipping the plate in pure water, and then washing it either with a weak solution of hypo-sulphite of soda or a saturated solution of common salt, and finally dipping it in the distilled water and drying it. It should then be framed and glazed to preserve it from external injury, and the picture will remain unchanged. Attempts have been made to use this process for preparing the plates for engravers, as much time and cost would thereby be saved, but hitherto it has not been done to any extent. The author presses upon the Institution the applicability of these processes to engineering uses, and quotes the remark of Mons. Arago—"That photographic delineations having been subjected during their formation to the rules of geometry, we may be enabled by the aid of a few simple data to ascertain the exact dimensions of the most elevated parts of the most inaccessible edifices."

Mr. Cooper introduced the subject of photography by explaining, and illustrating by instruments and diagrams, the principles of the division and dispersion of the rays of light, according to the Newtonian theory, as well as the most recent researches into the subject. He described the chemical properties of light—its affinity for certain combinations, such as chloride of silver—its heating powers—the different effects of the rays on vegetation—and the application of these known principles to photography. He then explained the chemical properties of the chloride of silver, iodine, and other substances used in the process. In alluding to the probable uses of the Daguerréotype, he observed that the process might be employed to make drawings of machinery, as graduated scales might be fixed to certain parts of the objects, and they would be copied in their relative proportions to the machine.

He described, among other points, the difficulty of obtaining pure silver upon the copper plates, as, for the advantage in rolling, the manufacturer will introduce an alloy of ½ to 1½ per cent. On this account, acid is used so repeatedly in cleaning the plates, that any particles of copper which have been rolled into the surface may be carried off. He explained his improvement to the iodine box, which consists in spreading the iodine all over the bottom of a tray lined with glass, and covering it it with a piece of card-board, which becomes saturated with the fumes of the iodine, and on the silvered plate being placed over it, acts equally over its surface, instead of partially, as in the old system of placing the iodine in a mass in the centre of the tray. He had found this to be a great improvement. The shortest time in which he had obtained a photographic picture in England was 11 minutes; while, during a gloomy day in November, it took an hour and a half to procure a moderately good one.

"An universal Screw-Jack." By George England.

This machine is intended for raising heavy weights, and moving them in any required direction; the vertical motion is similar to that of a common screw-lifting jack, and the lateral motion is communicated by a ratchet lever to a horizontal screw, working in bearings on a strong cast-iron bed with planed surfaces through a double nut attached to the base of the jack. The jack has been found useful for erecting heavy pieces of machinery, and for replacing railway carriages and locomotives on the rails when they have been accidentally thrown off.

"Description of a Traversing Screw-Jack." By W. J. Curtis.

This screw-jack is attached to a plank with a rack in it, and slides in a groove in another plank which is placed beneath it, across the railway; in the lower plank is a rack, by means of which and a hooked lever, the jack, with the engine or any other weight resting upon it, is drawn easily across the rails and lowered to its proper position. By this apparatus, engines and carriages of considerable weight have been replaced on a railway by two men in a very short space of time.

May 19, 1840.—"Description of a new Gas Regulator." By James Milne.

The object of this instrument is to regulate the supply of gas to burners, so that any variation in the pressure, arising from extinguishing the adjacent lights along the line of the street main, or in the different floors of manufactories, shall not affect those lights which are supplied through the regulator. The regulator consists of a cylindrical outer case, to which is affixed a water gauge to show the pressure; to the top is attached an inner cylinder, open at the lower end and reaching nearly to the bottom of the outer case; the gas is introduced from beneath by a tube in the centre, terminating in a conical vale at the top: the male part of the valve is fixed by three arms to the top of a float, which moves freely in the space between the inner cylinder and the centre tube; the areas between the outer case and the inner cylinder, and between the inner cylinder and centre tube, being alike, the pressure of the gas acts upon the water within the inner cylinder, and causes it to rise in the outer case just as much as it is depressed in the inner space. This depression carries down the float with the male part of the valve attached to it, and thus diminishes the aperture of the supply pipe, until the pressure is relieved by other burners being lighted, and enables the supply of gas to be in proportion to the demand. The pressure may be regulated at will by increasing or diminishing the quantity of water in the cylinders, and it is shown correctly by the graduated glass gauge. This apparatus has been found, in an experience of two years, to effect a saving of about 20 per cent., independent of its ensuring a perfect equality to all the burners in action.

"On the Properties and Chemical Constitution of Coal, with Remarks on the Methods of increasing its Calorific Effect, and preventing the Loss which occurs during its combustion. By Charles Hood, F.R.A.S., &c.

Previously to the seventeenth century, the smelting of iron and all other metals was performed by charcoal; but the attempts of Sturtevant and Ravenson, in 1612—1613, and of Dudley, in 1619, to introduce the use of coal or coke, in blast furnaces, having proved the pos-

sibility of success, the progress of the innovation, though slow, was certain, and led to the transfer of the iron works from many of the original positions in the midst of forests to the coal districts where they are now placed.

The author considers his subject under three heads: — 1st, The chemical character and composition of coal; 2dly, Its properties as a combustible; and, 3dly, The nature and application of its various gaseous products.

1st. The opinion that coal is a compound of carbon and bitumen has been objected to by some chemists, on the ground that by no process hitherto pursued in analyses has it been possible to resolve it entirely into these two substances: even at a low temperature a quantity of gaseous matter is thrown off, and, at an elevated degree of heat, an evident decomposition of the bitumen takes place. Even anthracite contains a small portion of volatile matter, its component parts being carbon, oxygen, hydrogen, and nitrogen; the hydrogen being either combined with the oxygen to form water, or with a small portion of carbon to form carburetted hydrogen, which exists in a gaseous state in the pores of the coal. In bituminous coal, the hydrogen is combined with a larger proportion of oxygen and nitrogen; the mechanical difference being, that the bituminous and free-burning coals, more particularly, melt by heat when the bitumen reaches the boiling point, whereas anthracite is not fusible, nor will it change its form, until it is exposed to a much higher degree of temperature.

Two tables of the analyses of different coals are given from the authorities of Mushet, Thomson, Vanuxem, Daniells, Ure, and Reynault; No. 1, showing the proportions of carbon, ashes, and volatile matter, with the specific gravity of the coal and of the coke; and No. 2 showing the proportions of carbon, hydrogen, azote, and oxygen. These tables show that the largest quantity of carbon (92·87), is contained in the Kilkenny anthracite, and the least quantity (64·72) in Cannel coal; and that the nature of the volatile matter greatly affects the quantity of coke — the aggregate quantity of the gaseous products of coking, splint, and cherry coal, being very nearly similar; while the quantity of coke obtained from these different species varies more than 45 per cent. The author then points out the continued presence of azote, which quits the base with the greatest difficulty; and also the affinity of sulphur, not only for the coal, but for the coke, as it is rarely found to have been completely expelled even from the most perfectly made coke; the only coal found to be even partially free from it being anthracite, in some species of which no traces of its presence are found.

2dly. The application of coal as a fuel depends on the chemical change which it undergoes in uniting by the agency of heat with some body for which it possesses a powerful affinity. In all ordinary cases this effect is produced by its union with oxygen. When coal is entirely consumed, the carbon is wholly converted into carbonic acid gas and carbonic oxide, and the hydrogen into water in a state of vapour. The atmosphere supplies the necessary oxygen for this purpose; and in this state the products of the combination are nearly or quite invisible, both of them being almost colourless fluids: if, therefore, any smoke be visible, it is the result of imperfect combustion. Some calculations are given to ascertain the amount of loss that is sustained when the smoke escapes unconsumed; from which it appears that, with bituminous coal, about 37 or 38 per cent. more heat is produced when the smoke is consumed than when it escapes freely. Many modes of consuming smoke have been attempted; those which appear to have been attended with the greatest success are — 1st. Causing the smoke from the fresh coals to pass through or over that portion of the fuel which is more perfectly ignited; 2dly. Supplying heated air to the top of the fuel, as well as admitting cold air through the ash-pit in the usual manner; and 3dly. Throwing a jet of steam into the furnace or into the chimney. The various modes of carrying into effect these plans are briefly alluded to; from them a few may be selected. Robertson's plan was to use inclined furnace bars, where the fresh coals were placed close to the fire-door, and being there partially carbonized, gave out the gas which in passing over the mass of incandescent fuel was ignited, and became active flame, thus economizing fuel and preventing smoke. In this and similar cases, by the slow distillation of the coal, a gas is produced, which not only inflames at a lower temperature than the dense olefiant gas produced by rapid distillation, but which only requires for its combustion a quantity of oxygen, never exceeding double its own volume, or ten times its bulk of atmospheric air, while olefiant gas requires three times its own volume of oxygen, or fifteen times its bulk of atmospheric air. The elimenation of a gas which burns with so small a portion of oxygen is, therefore, the principal cause of the non-production of smoke in furnaces of this description. The second mode of consuming smoke is founded on the necessity which exists for a large supply of air being requisite to inflame the gases given off from coal by a rapid and intense heat; and this is accomplished by introducing a quantity of heated air above the burning fuel. When a quantity of fuel is thrown into a furnace, the increased thickness of the mass opposes additional resistance to the passage of air through the bars; the temperature of the furnace is lowered, and an increased volume of gas is at the same time given out. If at this moment a quantity of air, heated to the temperature of the gas, be admitted, the gas immediately inflames, and that which would have produced a dense black smoke passes off in the invisible state of carbonic acid gas and vapour of water. Different gases require different degrees of heat to inflame them; and this explains the easy combustibility of the volatile products of coal when the heat is so managed as to produce those gases which inflame at the lowest temperature. A larger quantity of air is required at the time that the coal is first thrown on, than at a subsequent period; therefore, when economy is studied, the supply of air should be gradually diminished as the mass approaches an incandescent state. The use of heated air has produced most important results in the manufacture of iron with bituminous coal, and also with anthracite; the latter fuel having been almost neglected until the recent application of this principle of employing heated air to promote its combustion, although it is known to be capable of producing perhaps a more intense heat than any other carbonaceous fuel. The rationale of the third plan, of consuming smoke by injecting a jet of steam into the fire or the chimney, is less obvious than the others. In 1805, Mr. Davies Gilbert observed that, whenever the waste steam of one of Trevithick's engines was permitted to escape into the chimney, the smoke from the coal was rendered invisible. Subsequent experiments confirmed this fact; and it was supposed that the steam being decomposed furnished oxygen to support combustion. The author combats this opinion, and accounts for the effect by the increased draught of the furnace caused by the jet of steam into the chimney, by which means a larger portion of air is brought into contact with the burning fuel; thus supplying the previous deficiency of oxygen to the fire, and promoting the combustion. As steam is only about half the weight of air at a like temperature, and the power of all gaseous fluids to ascend is "*inversely* as the square roots of their specific gravities," the velocity of its escape by the chimney, compared with common air of the same temperature, is about as 1·4 to 1; therefore the compound mixture of steam, air, and carbonic acid gas, will escape with a considerable increased velocity, and more air must consequently enter the furnace. It appears that about 10 per cent. of the total quantity of steam generated is necessary to effect the combustion of the smoke by this means; therefore, unless the waste steam only be used, the saving of the fuel must be reduced by this amount. Brief mention is made of the experiments of Messrs. Apsley Pellatt, Parkes, and the Chevalier de Pambour, proving that a given quantity of oven coke will produce as much heat as the coal from which it was produced; and of the various kinds of artificial fuels which have been invented, especially that composed of resin and peat coke, of which the author remarks that its combustion probably produces a mechanical effect, as the hydrogen is converted into water in a state of vapour, which escapes through the chimney with a great velocity, and consequently a large quantity of air is drawn into the furnace, and a more perfect combustion of the fuel is the result. In the same manner he accounts for the necessity which exists for having the openings between the bars wider in a furnace in which coke is burned than in one used for coal. In opposition to the general opinion, he considers that less air is required for the consumption of coke than for coal; the carbon only requiring 2¼ times its weight of oxygen for its combustion, while the hydrogen contained in coal requires 8 times its weight of oxygen: and the only reason that the openings between the bars are required to be wider in the former than in the latter case is in consequence of the draught being so much slower during the combustion of coke.

3dly. On the nature and application of the volatile products of coal. In treating this portion of the subject — many of the observations on which have been necessarily anticipated in the preceding sections — the author traces the application of carburetted hydrogen gas to the purposes of artificial illumination from the year 1798, when its first successful application was made by Murdock at Soho; he then proceeds to Dr. Henry's investigations of the phenomena of its production and combustion; the variation of the intensity of light obtained from carburetted hydrogen, due to the proportion of carbon contained in it; the difference in the gas obtained from different qualities of coal; the superiority of the illuminating power of the gas from Cannel coal; and the still greater power of that produced from the decomposition of oil, which is 2 to 2½ times greater than that of coal gas. He then mentions the other products of coal by distillation, such as ammoniacal liquor, carbonic acid and oxide, sulphuretted hydrogen, tar, essential oil, naptha, petroleum, asphaltum, and other substances. The paper concludes by pointing out the advantages which would result from the production of such gas as is usually given out at the beginning of the distillation of coal, as it contains two volumes of gaseous carbon united with two volumes of hydrogen, and its illuminating power is consequently more than double that of ordinary coal gas.

MISCELLANEOUS.

TRIAL OF ENGINES.—On five days, experiments were made on the Hull and Selby line, with three descriptions of locomotive engines, namely, three of the six-wheeled engines furnished by the celebrated makers, Fenton, Murray, and Jackson, of Leeds, to the Hull and Selby Company, on the opening of the line less than six months ago, three other of the same engines, altered, so far as practicable, to employ Gray's patent motion for the saving of steam, and two new engines, constructed at Leeds, by Messrs. Shepherd and Todd, under the directions of Mr. Gray himself, who is superintendent of the engineering department of the Hull and Selby Railway. There were fifty experimental trips made in the presence of Messrs. J. Miller and T. Lindsley, representatives of Messrs. Fenton, Murray, and Co.; Messrs. J. Craven and J. Barrows, representatives of Messrs. Shepherd and Todd; and Messrs. Fletcher, Bray, Lynde, Farnell, and Gray, representatives of the Hull and Selby Railway Company. The particulars of loading, fuel, and water, are before us. The average gross load of all the fifty trips was 53·2 tons, or 1649·4 lbs. over one mile, and, taking that as a standard load, the consumption of fuel and water performing exactly equal quantities of work is represented as follows:

	Class of Engine.		
	Patent.	Altered.	Unaltd.
Load in lbs., carried over one mile . .	1649·4	1649·4	1649·4
Elsecar coke, per trip of 31 miles, in lbs.	446·98	686·15	1007·78
Coke used per mile, in lbs. . . .	14·41	22·13	32·59
Coke used per ton per mile, in lbs. . .	0·271	0·416	0·611
Water used per trip of 31 miles, in lbs. .	2672·	4601·8	6432·6
Water per mile, in lbs.	86·19	148·43	207·5
Water per ton per mile, in lbs. . .	1·62	2·79	3·90

The financial annual result of the three classes of engines, for coke and boilers, with such a traffic as that of the Hull and Selby line, will be about £4,500 for the unaltered, £3,250 for the altered, and £2,000 for the patent engines. The unaltered engines throw out hot cinders from the funnel, which is not the case with either the patent or altered ones.

SPECIMEN OF ART.—The iron viaduct on the Manchester and Birmingham Railway reflects the greatest credit on all parties concerned in its construction; the design (by Mr. Buck, the engineer to the company) has been carried out with considerable skill by Messrs. Bramah, Fox, Grazebrook, and others, employed in its execution. The weight of iron is about 580 tons. The erection crosses the line of the railway at Fairfield-street, Manchester, at the acute angle of 24½ degrees, which is a greater obliquity than that of any arch hitherto erected in Great Britain. The abutments are constructed of massive pieces of the Summit stone; and each abutment is divided into six compartments perpendicular to the ribs composing the bridge. The joints of the masonry are parallel to each other—an adaptation to the circumstances of the case—which secures its binding together. The bridge consists of six arches, or ribs, tied together by diagonal braces. The span of each rib is 130 feet; the height of the arch from the springing line 12 feet; the height of the roadway 24 feet; the height, from the pavement to the top of the rails, 30 feet; and to the top of the parapet 36½ feet. Each rib is a segment of a circle whose diameter is 357 feet.

LIST OF PATENTS.

Continued from page 263.

(SIX MONTHS FOR ENROLMENT.)

Miles Berry, of Chancery-lane, patent agent, for "certain improvements in looms for weaving."—Sealed November 27.

John Clay, of Cottingham, York, gentleman, and Frederick Rosenborg, of Sculcoates, in the same county, gentleman, for "improvements in arranging and setting up types for printing."—Sealed November 27.

John Condie, Manager of the Blair Iron Works, Ayr, Scotland, for "improvements in applying springs to locomotive railway and other carriages."—Sealed November 27.

George Holworthy Palmer, of Surrey-square, civil engineer, and Charles Perkins, of Mark-lane, merchant, for "improved constructions of pistons and valves for retaining and discharging liquids, gases, and steam."—Sealed November 28.

George Blaxland, of Greenwich, engineer, for "an improved mode of propelling ships and vessels at sea, and in navigable waters."—Sealed November 28.

Henry Bridge Cowell, of Lower-street, St. Mary, Islington, ironmonger, for "improvements in taps to be used for or in the manner of stopcocks for the purpose of drawing off and stopping the flow of fluids."—Sealed December 2.

James Robinson, of the Old Jewry, manufacturer of machinery for "a sugar cane mill of a new construction, and certain improvements applicable to sugar cane mills generally, and certain improvements in apparatus for making sugar."—Sealed December 2.

Alexander Horatio Simpson, of New Palace-yard, Westminster, gentleman, for "an improved machine or apparatus for working pumps," being a communication.—Sealed December 9.

William Pierce, of George-street, Adelphi, gentleman, for "improvements in the preparation of wool, both in the raw and manufactured state, by means of which the quality will be considerably improved."—Sealed December 9.

Charles Winterton Baylis, of Birmingham, accounting house clerk, for "an improved metallic pen, to be called the patent flexion pen, and an improved pen holder."—Sealed December 16.

George Wildes, of the city of London, merchant, for "improvements in the manufacture of white lead," being a communication.—Sealed December 16.

James Davis, of Shoreditch, engineer, for "an improved mode of applying heat to certain steam-boilers."—Sealed December 16.

John Steward, of Wolverhampton, esq., for "an improvement in the construction of piano-fortes, harpsichords, and other similar stringed musical instruments."—Sealed December 16.

James Molyneux, of Preston, for "an improved mode of dressing flax and tow."—Sealed December 16.

Charles Bolton, of Farringdon-street, gas engineer, for "a certain improvement in gas meters."—Sealed December 16.

Hugh Graham, of Bridport-place, Hoxton, artisan, for "a new mode of preparing designs, and dyeing the materials to be used in the weaving and manufacture of Kidderminster carpets, and for producing patterns thereon, in a manner not before used or applied in the process of weaving, and manufacturing such carpets."—Sealed December 16.

Joseph Beathi, of Portland-place, Wandsworth-road, Lambeth, engineer, for "certain improvements in locomotive engines, and in carriages, chairs, and wheels, for use upon railways, and certain machinery for use in the construction of parts of such inventions."—Sealed December 16.

Andrew Pruss D'Olszowski, of Ashley-crescent, gentleman, for "a new and improved level for ascertaining the horizon and the several degrees of inclination," being a communication.—Sealed December 16.

William Tudor Mabley, of Wellington-street, North, mechanical draftsman, for "certain improvements in producing surfaces to be used for printing, embossing, or impressing."—Sealed December 17.

Abraham Alexander Lindo, of Finsbury-circus, gentleman, for "improvements to be applied to railways, and carriages thereon, to prevent accidents, and to lessen the injurious effects of accidents to passengers, goods, and railway trains."—Sealed December 18.

Elias Robinson Handcock, of Birmingham, esq., for "certain improvements in mechanism applicable to turn-tables for changing the position of carriages upon railroads, for furniture, and other purposes."—Sealed December 18.

Richard Coles, of Southampton, merchant, for "improvements in making or manufacturing tanks, and other vessels of slate, stone, marble, and other materials; and in fitting and fastening such materials together."—Sealed December 23.

Benjamin Baillie, of Henry-street, Middlesex, for "improvements in locks, and the fixings and fastenings thereto belonging."—Sealed December 23.

John Brumwell Gregson, of Newcastle-upon-Tyne, soda water manufacturer, for "improvements in pigments, and in the preparation of sulphates of iron and magnesia."—Sealed December 23.

Frederick Payne Mackelcan, of Birmingham, and James Murdoch, of Hackney-road, civil engineers, for "certain improvements of, or belonging to, tables, a portion of which is applicable to other articles of furniture," being partly a communication.—Sealed December 23.

George Thornton, of Brighton, civil engineer, for "certain improvements applicable to railways, locomotive engines, and carriages."—Sealed December 23.

John Dickinson, of Bedford-row, Holborn, esq., for "certain improvements in the manufacture of paper."—Sealed December 23.

David Walther, of Angel-court, Throgmorton-street, merchant, for "certain improvements in the methods of purifying vegetable and animal oils, fats, and tallows, in order to render those substances more suitable to soap making, or for burning in lamps, or for other useful purposes, part of which improvements are also applicable to the purifying of the mineral oil or spirit, commonly called Petrolium or Naptha, or coal oil, or spirit of coal tar," being a communication.—Sealed December 23.

John Jones, of Leeds, brush manufacturer, for "certain improvements in carding engines for carding wool, or other fibrous substances," being a communication.—Sealed December 23.

Joseph Barker, of Regent-street, artist, for "improvements in gas meters."—Sealed December 23.

Clarke, Printers, Silver Street, Falcon Square, London.

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